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FURFURAL CONTENT OF SOME PHILIPPINE AGRICULTURAL RESIDUES

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The industrial utilization of agricultural residues in the Philippines has not been extensively attempted. Rice, corn, coconut, sugar cane, coffee beans, and many other local crops are sources of such residues. The utilization and exploitation of these by-products spell promise for the creation of new industries in the Philippines, which may lead to more new jobs and may partially solve the unemployment problem of the country. The exploitation of such residues would also mean more income to the farmer, if not lead to national economic stability.

Since the Philippines is essentially an agricultural country, practically her whole population would be favorably affected by industries which may be established for the exploitation of agricultural residues. At present, however, some of these by-products are used for fuel and animal feed only and the rest go to waste.

Agricultural residues that may be obtained from the yearly yield of basic crops * are estimated to amount to the following:

Rice hulls	46,503,558	kilos
Coconut shell	822,824,039	do
Sugar cane bagasse	3,020,766,089	do
Corncobs	368,155,199	do
Cornhusks	653,215,531	do
Cornstalks (4")	403,954,696	do
Coffee bean shells	2,760,407	do
Peanut shells	3,436,897	do

Plastics are at present considered one of the most important materials that go into the making of most of life's requirements, such as clothing, many household articles, even automobile parts, including machineries. Statistics show that plastics in the form of finished and unfinished products or plastic materials amounting to ₱4,160,902 were imported into the Philippines from January to April, 1953, alone. This means practically double the amount of import for this category for the whole year previous. (Table 1)

TABLE 1.—*Importation of plastic materials.*

	1952 January–December	1953 January–April
Plastic materials other than pyroxylin products	₱2,188,060	₱4,160,902
In the form of:		
Belts	7,704	4,132
Beltings	160,778	130,392
Bottle caps	155,270	129,816
Buttons	264,090	385,938
Combs	148,948	115,112
Pocket books, purses, wallets and handbags	58,072	46,666
Safety razors		480
Eyeglass frames and mountings	29,432	54,464
Sandals and slippers	30	26
Sheets and sheetings	669,078	2,569,576
Solings and heelings	9,540	
Tableware	80,156	126,244
Toilet articles (powder boxes, pin trays, compacts, etc.)	151,574	48,788
Water-proof garments	12,310	5,086
Other wearing apparel	424	1,368
All other plastic manufactures	440,654	542,814

* Yield of basic crops for a period ending June 30, 1953, from 52 provinces:

Rice	71,455,990	kilos
Corn	15,735,280	cavans
Coconut	3,702,760,200	nuts
Sugar cane	11,827,588	tons
Coffee	5,710,400	kilos
Peanut	12,945	tons

Furfural obtained from agricultural residues has among others, the following uses:

1. As a material in the manufacture of nylon, where furfural is converted to adiponitrile, the principal intermediate for nylon;
2. As one of the chemicals used in the purification of butadiene for synthetic rubber;
3. As furfural phenol in the manufacture of phenolic resins, which are marketed in the form of plastic molding powders;
4. As a selective solvent in refining petroleum lubricating oils;
5. As a coloring-matter extractor in the purification of wood resin;
6. As a solvent for high iodine-number fraction in their separation from vegetable and animal glyceride oils;
7. As a chemical in the manufacture of commercial products;
8. As a dispersant and as a solvent for potentially reactive phenolic resins, cellulose esters, natural gums, etc.; and
9. As a disinfectant, fungicide, and bactericide.

In the United States, various government laboratories and the Quaker Oats Company at Cedar Rapids, Iowa, have worked on the extraction of furfural, especially from corncobs and oat hulls. At La Romana, Dominican Republic, the Central Romana By-Products (a division of South Porto Rico Sugar) has recently used bagasse for the same purpose. The newest and largest furfural plant in the world is at Memphis, Tennessee. The plant was being operated for the United States Government by a subsidiary of the Quaker Oats Company until 1946, when the Quaker Oats Company purchased it.

The data gathered as a result of the work done by the Northern Regional Laboratories in Peoria, Illinois, and the Quaker Oats Company, Cedar Rapids, Iowa, show a yield of 9 to 10 per cent furfural from oat hulls and corncobs.

In line with the studies on furfural in particular conducted in other countries, the Institute of Science and Technology undertook a similar study to survey local agricultural residues as possible sources of furfural. The study was spurred by the urgency of the need for local sources of plastic materials, since at present plastic molding plants in the Philippines depend wholly on imported plastics. This paper is a report of the findings as a result of such a study. Tables 2 and 3 show the percentages of moisture, furfural, pentosan, and pentoses in some agricultural residues which were analyzed for the purpose.

TABLE 2.—*Percentages of moisture, furfural, pentosan, and pentoses in some agricultural residues.*

Sample	Moisture	Furfural	Pentosan	Pentoses
	Per cent	*Per cent*	*Per cent*	*Per cent*
Coconut shell	8.88	14.77	25.15	28.53
Coconut coir dust	14.78	6.13	10.48	11.90
Coconut husk	13.26	6.09	10.42	11.84
Copra meal	11.68	1.07	1.82	2.07
Corncob	9.82	16.02	27.30	31.01
Corn-husk	11.42	17.19	29.28	33.27
Cornstalk	11.17	16.03	27.31	31.04
Cassava stalk	8.81	4.14	7.07	8.04
Rice hull	7.42	9.10	15.50	17.61
Sugar cane bagasse	13.78	13.43	22.87	25.98
Coffee shell, Inner ("Barraco")	13.71	8.87	15.12	17.19
Coffee shell, Outer ("Barraco")	14.05	3.91	6.71	7.62
Coffee shell, Inner ("Excelsa")	10.99	10.50	17.88	20.31
Coffee shell, Outer ("Excelsa")	10.02	6.73	11.53	13.10
Lumbang shell	8.61	6.57	11.24	12.77
Pili nut shell	10.41	12.05	20.53	23.32
Peanut shell	15.34	8.00	13.63	15.49
Sawdust (Wood)	9.57	6.78	11.60	13.18
Narra (Wood)	10.06	6.03	10.31	11.77
Tangile (Wood)	10.68	4.13	7.05	8.02
Ipil (Wood)	12.15	3.75	6.42	7.29
Yacal (Wood)	8.34	5.50	9.44	10.72
Molave (Wood)	8.52	5.23	8.95	10.18

TABLE 3.—*Percentages of furfural, pentosan, and pentoses (moisture-free basis) in some agricultural residues.*

Sample	Furfural	Pentosan	Pentoses	Remarks
	Per cent	*Per cent*	*Per cent*	
Coconut shell	16.20	27.60	31.31	Recommendable for use
Coconut coir dust	7.19	12.30	13.96	----------
Coconut husk	7.02	12.01	13.65	Recommendable for use
Copra meal	1.21	2.06	2.34	----------
Corncob	17.76	30.27	34.38	Recommendable for use
Cornhusk	19.41	33.05	37.56	do
Cornstalk	18.00	30.74	34.94	do
Cassava stalk	4.54	7.76	8.82	----------
Rice hull	9.82	16.94	19.02	Recommendable for use
Sugar cane bagasse	15.51	26.29	30.13	do
Coffee shell, Inner ("Barraco")	10.28	15.85	20.96	do
Coffee shell, Outer ("Barraco")	4.55	7.80	8.87	May be used with inner shell.
Coffee shell, Inner ("Excelsa")	11.79	20.10	22.82	Recommendable for use
Coffee shell, Outer ("Excelsa")	7.47	12.81	14.55	----------
Lumbang shell	7.19	12.30	12.77	----------
Pili nut shell	13.45	22.93	25.91	Recommendable for use
Peanut shell	9.45	16.70	18.29	May be used
Sawdust (Wood)	7.50	12.83	14.57	----------
Narra (Wood)	6.70	11.46	11.77	----------
Tangile (Wood)	4.62	7.89	8.97	----------
Ipil (Wood)	4.27	7.32	8.31	----------
Yacal (Wood)	6.00	10.21	11.69	----------
Molave (Wood)	5.71	9.77	11.12	----------

Such agricultural residues as coconut shells, sugar cane bagasse, corncobs, rice hulls, coffee bean shells, peanut shells, and the like, were analyzed.

MATERIALS AND METHODS

The amount of residue from each kind of crop used was determined by weighing the whole grain or nut, the shell and meat and computing the percentage from the weights obtained.

The following gives the percentages of residue obtainable from some common agricultural crops:

Corn (Yellow)	
Cornstalk (1" stem)	9.07
Cornhusk	30.05
Corncob	16.42
Silk thread	8.74
Coconut [a]	
Husk	12.46
Shell	18.17
Sugar cane [b]	
Sugar cane bagasse	25.54
Rice Grain	
Rice hull	39.44
Coffee Beans ("Barraco" Variety)	
Inner shell	22.30
Outer shell	39.38
Coffee Beans ("Excelsa" Variety)	
Inner shell	14.50
Outer shell	20.50
Peanut	
Shell	26.55
Lumbang nut	
Shell	65.04

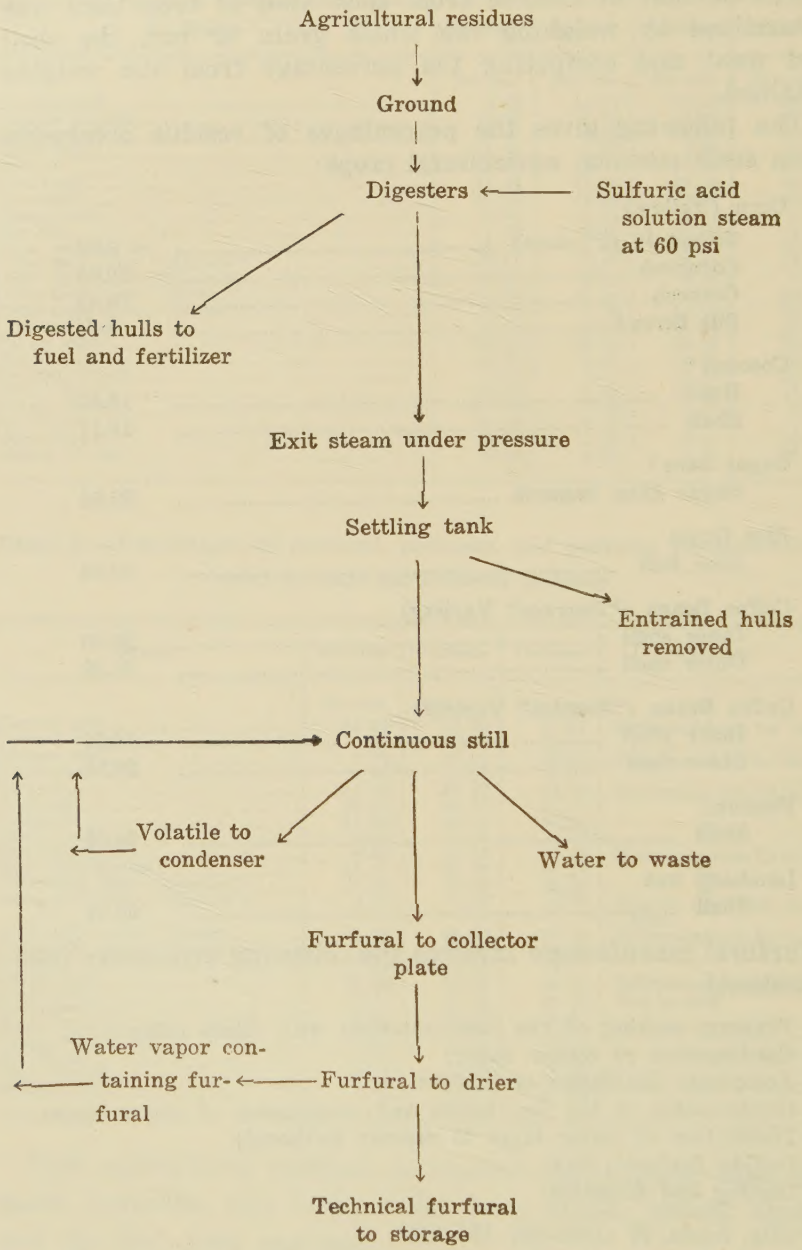
Furfural manufacture involves the following processes: (See Flowsheet)

1. Pressure cooking of the raw materials with dilute acid;
2. Condensation of cooker vapor;
3. Azeotropic distillation of furfural;
4. Condensation of the two layers and decantation of water layer;
5. Distillation of water layer to recover methanol;
6. Drying furfural; and
7. Cooling and filtration.

[a] Philip. Agric. 20 (1931–32) 195–198.

[b] Annual synopsis of mill data for the crop year 1953–1954. Philip. Sugar Assoc. (1954).

FLOW SHEET FOR FURFURAL PRODUCTION



In analyzing the residues for their moisture, furfural, pentoses, and pentosan contents the procedure given in the Official and Tentative Method of the Association of Official Agricultural Chemists * was used.

RESULTS AND DISCUSSION

From the findings obtained in the analyses made of these residues it was noted that several of them gave quite promising results. As shown in Tables 2 and 3, the following residues analyzed are deemed high in furfural content:

	Moisture-free basis *Per cent*
Coconut shell	16.20
Corncobs	17.76
Corn hull	19.41
Cornstalks	18.00
Rice hull	9.82
Coffee inner shell Excelsa	11.79
Coffee inner shell Barraco	10.28
Pili nut shell	13.45
Peanut shell	9.45
Sugar cane bagasse	15.51

These residues that gave high furfural content form the great bulk of agricultural residues in the Philippines. They are then a good source of raw material for the extraction of furfural locally.

SUMMARY

1. Agricultural residues utilizable for industrial purposes amount to 5,500,000 tons a year.

2. Various agricultural residues abundant in the Philippines were analyzed for their furfural, pentoses, and pentosan contents.

3. Coconut shell, corncob, corn hull, corn-stalk, sugar cane bagasse, rice hull, coffee inner shell, pili nut shell, and peanut shell were found to contain high furfural content ranging from 9.45 to 19.41 per cent (moisture-free basis).

4. Cellulose and lignin residues obtained after the extraction of furfural may be used in the manufacture of paper.

5. The industrial possibilities of local agricultural residues may be seen from the fact that these residues abound in the Philippines. Among these possibilities are the manufacture of plastics, nylon, paper, insecticides, and medicinals.

* *Loc. cit.* (1945) 412–414.

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THE FLIES OF THE GENUS MUSCA IN THE PHILIPPINES

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THREE PLATES

INTRODUCTION

One of the most annoying groups of insects in the Philippines is made up of several species of flies belonging to the genus *Musca*. These species may be divided into two groups, one of which is associated with homes, markets, garbage dumps, and the like, and the second with domestic animals. In the former are the species with non-blood sucking mouth parts; in the latter are hematophagous species with mouth parts modified into more or less efficient skin- or scab-scratching organs. The species of the second group are especially annoying to carabaos. These flies will suck blood from wounds and sores, and a favorite site of attack is the inner surface of the outer ear, which may be scraped by the flies' mouth parts until it is entirely raw. Not only do the flies cause great direct annoyance to carabaos, but they are probably highly efficient vectors of pathogenic organisms such as *Trypanosoma evansi* (see Mitzmain, 1914; Thomson & Lamborn, 1934). *M. crassirostris* will bite through the intact skin; we have not been able to determine to what extent other species with mouth parts that structurally appear to be efficient biting organs will also penetrate the intact skin. The hematophagous species represent an interesting demonstration in evolution of the blood-sucking mouth parts, and it would be of interest to determine at what stage in the series blood becomes essential for ovarian development. We have observed *M. inferior*, which is an advanced blood sucker, feeding upon fresh cow dung, and dissection of flies caught in the immediate vicinity of dung has shown their guts to be filled with this material.

Little is known of the breeding habits of the Philippine *Musca* species. The non-blood suckers, especially *M. domes-*

tica vicina and *M. sorbens,* are abundant in garbage dumps, and the multitudes of larvæ that we have seen in decomposing garbage included these species as well as *Chrysomyia* and other genera. The hematophagous species appear to breed in fresh carabao and cow dung.

In 1923 Patton reviewed the Philippine *Musca* and listed 11 species. It was our purpose to extend these early studies of Patton in order to determine whether additional species are present in the Islands, and to revise the descriptions and keys for greater certainty in identification.

Flies were collected for the most part with the aid of a net, by sweeping bushes, grass, and the surface of breeding places or other decaying material, where the insects were resting or feeding. Hematophagous species were captured directly from carabaos, from vegetation near these animals where blooded flies were resting, and from animal-baited traps which were being operated in connection with malaria control.

ABUNDANCE

Our collection methods do not permit an accurate estimate of the relative abundance of the various species. However, a comparison of total numbers of flies captured in various situations gives one an impression of their prevalence. These data are summarized in Table 1. It will be noted that the important species in the domestic environment are *M. domestica vicina* and *M. sorbens.* With the exception of a few specimens of *M. conducens* and *M. inferior,* all of the hematophagous flies were taken on animals or near animals or in animal-baited traps.

TABLE 1.—*Numbers of flies collected.*

Species	Collection sites		
	Houses, markets	Garbage dumps	Animals and vicinity
M. d. vicina	69	255	12
M. d. nebulo			1
M. sorbens	575	27	19
M. vetustissima		2	7
M. ventrosa			1
M. craggi			15
M. bakeri			43
M. conducens	5		259
M. planiceps			1
M. inferior	2		137
M. gibsoni			14
M. senior-whitei			12
M. crassirostris			50
Totals	651	284	571

TAXONOMIC CHARACTERS

In his keys to species of the Philippine *Musca,* Patton (1923) relied mostly upon relative size and coloration patterns. At present, other structural characters are available which make identification much more certain. The structure of the mouth parts, even in uncleared, dry material, will usually show whether a specimen belongs to the hematophagous or non-hematophagous group. However, it is necessary to clear and dissect the mouth parts in order to see the detailed structure, and occasionally it may be desirable to dissect them in order to identify a specimen accurately. This procedure consists of removing the head, maceration in KOH or NaOH, dehydration in alcohol, clearing in creosote or similar medium, and mounting on slide in balsam. The structure of the mouth parts of *M. domestica* has been described in many standard reference texts (for example, see Matheson, 1950; Metcalf, Flint, and Metcalf, 1951; West, 1951). In the non-hematophagous group the mouth parts are for sponging; the labella are large and completely obscure the small discal (or prestomal) sclerite, and the prestomal teeth are weakly sclerotized. In an uncleared specimen one sees only the large labella. The following Philippine species belong to this group: *M. domestica vicina, domestica nebulo, sorbens, vetustissima,* and *ventrosa.* In the hematophagous group, the labella are reduced, the discal sclerite is large and armed with several strong, heavy denticles. The discal sclerite with its armature of denticles usually can be seen clearly even in uncleared specimens, extending beyond the small labella. Mouth parts of this type are illustrated in Plate 1, fig. 3.

A lateral view of the thorax of *Musca* is shown in Plate 1, fig. 1. Two characters of special importance are the presence or absence of setæ on the propleuron, and on the suprasquamal ridge.

Other characters for confirmation of specific identity are found in the male terminalia. These require clearing and dissection. The terminalia of various species have been described by Patton (1932, 1933, 1936, 1937). We have included illustrations of the male phallosome of most of the Philippine species.

CLASSIFICATION

A number of subgenera of *Musca* are recognized by several authors. The classification of the Philippine species is given

below in accordance with the subgenera recognized by Van Emden (1939). Following a suggestion by Dr. Curtis Sabrosky, United States National Museum, we have listed *M. inferior* under *Ptilolepis*.

Subgenus MUSCA L.

Propleura with hairs, suprasquamal ridge bare.

1. *domestica vicina*
2. *domestica nebulo*

Subgenus BIOMYIA R.-D.

Propleura bare, suprasquamal ridge also bare, front tibia with a submedian postero-ventral bristle.

3. *sorbens*
4. *vetustissima*
5. *planiceps*
6. *conducens*
7. *ventrosa*

Subgenus PHILAEMATOMYIA Austen

Propleura and suprasquamal ridge bare, midtibia with a distinct anteroventral postmedian bristle, mentum bulbous, palpi orange.

8. *crassirostris*

Subgenus EUMUSCA Townsend

Propleura bare, parasquamal tuft absent (posterior part of ridge) but tympanic tuft present (anterior part of ridge).

9. *senior-whitei*
10. *craggi*

Subgenus VIVIPAROMUSCA Townsend

Propleura bare, parasquamal and tympanic tufts present, dorsal surface of squama without hairs, vein R_{4+5} with hairs extending beyond the r-m cross vein.

11. *bakeri*
12. *gibsoni*

Subgenus PTILOLEPIS Bezzi

Same as *Viviparomusca* except the presence of hairs on dorsal surface of squama.

13. *inferior*

Key to known Philippine species of Musca

MALES

1. Mouth parts adapted for lapping or sponging, prestomal teeth not readily visible, (non-hematophagous species) 2
   Mouth parts adapted for scratching or piercing with prestomal teeth readily visible, labella reduced; (hematophagous species) 7
2. Propleura with hairs 3
   Propleura without hairs 4
3. Front wide, about ¼ to ⅓ the eye width; 2nd tergite orange with black median stripe expanding anteriorly, 3rd tergite yellow with black median stripe and dark brown admedian stripe.
   domestica vicina

Front narrow, about 1/6 to 1/8 the eye width; 2nd tergite light orenge with broad median black stripe and silvery margins, 3rd tergite orange with black median and admedian stripes, and silvery margins ..... *domestica nebulo*

4. Scutum with 2 black stripes 5
   Scutum with 4 black stripes 6
5. Front narrow, about 1/6 to 1/8 the eye width; scutum greyish; 1st abdominal sternite dark brown, the others orange; dorsal free arm of prestomal sclerite not arched ..... *sorbens*
   Front very narrow, about 1/12 to 1/14 the eye width; scutum bluish; all abdominal sternites black or dark brown; dorsal free arm of prestomal sclerite arched ..... *vetustissima*
6. Suprasquamal ridge without black hairs; vein R_{4+5} without small setæ on ventral side beyond radio-medial cross vein; scutum dark bluish-grey with indistinct stripes; abdominal tergites entirely orange; sclerotized part of phallosome body slender and equal in length to membranous part, posterior process long and expanded distally ..... *ventrosa*
   Suprasquamal ridge with black hairs (parasquamal and tympanic tufts present); vein R_{4+5} with small setæ on ventral side extending beyond radio-medial cross vein; scutum bluish-grey with distinct broad stripes; abdominal tergites with distinct stripes and bands; sclerotized part of phallosome body short and wide, membranous portion long, posterior process very long and bent upwards, with wide shallow fork at end ..... *gibsoni*
7. Suprasquamal ridge and propleura without black hairs 8
   Suprasquamal ridge with black hairs but propleura bare 10
8. Palpi orange; mentum swollen and sclerotized, forming a bulb at base of proboscis ..... *crassirostris*
   Palpi black; mentum not markedly swollen 9
9. Front very narrow, about 1/14 to 1/16 the eye width; scutum greenish-grey with 4 narrowly separated stripes; 1st abdominal tergite black; 2nd tergite yellow with dark median stripe and incomplete orange band at posterior border, 3rd tergite yellow with narrow median dark stripe and orange admedian stripes; prestomal sclerite short, part carrying dental plate arched, axial apophysis long, pointed and directed forwards beyond dental plate; 5 pairs of teeth with serrated ends; sclerotized part of phallosome body slender and waisted; posterior process curved ..... *conducens*
   Front narrow, about 1/8 to 1/10 the eye width; scutum light grey with 4 widely separated black stripes; 1st abdominal tergite yellow with narrow median black stripe; 2nd tergite yellow with dark narrow median stripe with ends expanded, a pair of triangular yellow admedian stripes with intervening and marginal areas pollinose yellow; 3rd tergite similar except for narrower median stripe and brownish admedian stripes; prestomal sclerite, especially dorsal free arm, short and wide; dental plate well developed, arched and extending beyond blunt axial apophysis; 10 pairs of strong teeth sclerotized part of phallosome body wide and long, posterior process straight ..... *planiceps*

10. Only tympanic tuft present 11
Both parasquamal and tympanic tufts present 12
11. Vein R_{4+5} with setæ on ventral side extending beyond radio-medial cross vein; scutum grey with bluish tinge, 4 widely separated black stripes; 1st abdominal tergite black with 2 yellowish spots at posterior border; 2nd tergite yellowish with broad black median, brown admedian stripes, and greyish-yellow margins; 3rd tergite similar but median stripe narrower; prestomal sclerite wide, with stout dorsal free arm; sclerotized part of phallosome body short, posterior process long, bent and deeply forked ..... *senior-whitei*
Vein R_{4+5} without setæ on ventral side beyond radio-medial cross vein; scutum bluish-grey with 4 black stripes, inner pair narrow anterior to suture; 1st abdominal tergite black; 2nd tergite orange with broad median dark stripe spreading out anteriorly, margins silvery; 3rd tergite orange with narrow median stripe and band at posterior border, margins yellowish; prestomal sclerite long and narrow; sclerotized part of phallosome body short with slight waist, posterior process markedly curved and widely forked distally ..... *craggi*
12. Squamæ without setæ on dorsal surface; palpi black; front very narrow about 1/12 to 1/14 the eye width; prestomal sclerite short and narrow; axial apophysis short, blunt and directed forward; 4 pairs of teeth with strongly sclerotized bases ..... *bakeri*
Squamæ with setæ on dorsal surface; palpi orange; front wide, about 1/4 to 1/5 the eye width; prestomal sclerite short and wide; axial apophysis long, pointed, well developed and directed forward beyond dental plate; 5 pairs of strong teeth ..... *inferior*

FEMALES

1. Mouth parts adapted for lapping or sponging, with prestomal teeth not readily visible (non-hematophagous species) 2
Mouth parts adapted for scratching or piercing, with prestomal teeth readily visible (hematophagous species) 7
2. Propleura with hairs 3
Propleura bare 4
3. 1st abdominal tergite brownish-orange with broad median black stripe expanding anteriorly; 2nd tergite orange with broad black stripe, dark brown admedian stripes and yellowish margins; 3rd tergite similar but the median and admedian stripes narrower. *domestica vicina*
1st abdominal tergite light orange with black anterior border; 2nd tergite with extensive silvery markings, a broad median black stripe, dark admedian stripe and silvery margins; 3rd tergite similar ..... *domestica nebulo*
4. Scutum with 2 black stripes 5
Scutum with 4 black stripes 6
5. Scutum greyish; 2nd and 3rd abdominal tergites yellow with black stripes and bands; 2nd to 5th abdominal sternites orange .... *sorbens*
Scutum bluish-grey; 2nd and 3rd abdominal tergites bluish-grey with black stripes and bands; all abdominal sternites black .... *vetustissima*

6. Suprasquamal ridge without black hairs; vein R_{4+5} without small setæ on ventral side beyond the radio-medial cross vein; scutum dark bluish-grey with indistinct stripes that appear fused; abdominal tergites entirely orange without markings ..... *ventrosa*
   Suprasquamal ridge with black hairs (parasquamal and tympanic tufts present); vein R_{4+5} with small setæ on ventral side extending beyond the radio-medial cross vein; scutal stripes distinct; 1st abdominal tergite brown or dark orange with black anterior and posterior borders and black median stripe which may be incomplete, the remaining tergites with distinct stripes and bands ..... *gibsoni*
7. Suprasquamal ridge and propleura without black hairs 8
   Suprasquamal ridge with black hairs but propleura bare 10
8. Palpi orange; mentum markedly swollen ..... *crassirostris*
   Palpi black; mentum not markedly swollen 9
9. Parafrontal setæ arranged in single row; 1st abdominal tergite entirely black or occasionally dark brown, 2nd tergite greenish-grey with dark median stripe spreading out along the anterior and posterior borders to form bands ..... *conducens*
   Parafrontal setæ arranged in 2 rows; 1st abdominal tergite light orange without any definite markings except a median dark spot on posterior border, 2nd tergite orange with dark median stripe, the others yellowish ..... *planiceps*
10. Parasquamal tuft absent but tympanic tufts present 11
    Both parasquamal and tympanic tufts present 12
11. Vein R_{4+5} with setæ on ventral side beyond the radio-medial cross vein; scutum with 4 widely separated black stripes; 1st abdominal tergite black with 2 bluish-yellow spots at posterior margin and broad black median stripe; 2nd tergite bluish-grey with broad black median and admedian stripes and yellowish margins; abdominal sternites black ..... *senior-whitei*
    Vein R_{4+5} without setæ on ventral side extending beyond the radio-cross vein; scutum with 4 narrowly separated black stripes; 1st abdominal tergite dark brown to black, 2nd tergite dark orange to brown with broad median black stripe spreading out along anterior and posterior margins to form bands, areas at both sides of median stripe and margins of tergites yellowish; abdominal sternites orange ..... *craggi*
12. Squamæ without hairs on dorsal surface; palpi black ..... *bakeri*
    Squamæ with hairs on dorsal surface; palpi orange ..... *inferior*

NOTES ON SPECIES

1. MUSCA DOMESTICA VICINA Macquart.

Male.—Head: Front about ¼ to ⅕ the eye width; third antennal segment, arista and palpi black; mentum and labella normal size. Prestomal teeth not visible on pinned specimens. The dissected, mounted mouth parts (Plate 1, fig. 5) show 5 pairs of weak, slightly sclerotized teeth that are of equal size with serrated ends. Teeth attached directly to prestomal

sclerite, dental plate absent. Interdental armature consisting of sclerotized rods surrounding terminations of pseudotracheæ. Prestomal sclerite long and narrow with dorsal free arm arched; axial apophysis bluntly pointed and directed downwards and a little forward. Thorax: Ground color dark grey with 4 black stripes; propleura with hairs but suprasquamal ridge bare. Three pair presutural dorso-central setæ, the most anterior small; 4 pair postsutural dorso-central setæ and 1 pair of postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 1, rarely 2 hairs; veins R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: * First abdominal tergite orange with dark brown or black anterior border and broad median dark stripe; second tergite orange with broad dark median stripe expanding anteriorly, lateral margins of tergite yellow; third tergite yellow with narrower dark median stripe and dark brown admedian stripes, lateral margins yellow. First sternite dark brown; the remaining tergites orange. Terminalia (Plate 1, fig. 5): Sclerotized part of phallosome body stout and slightly longer than membranous part; posterior process rather short, stout, and not expanded distally.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in 2 rows; third antennal segment, arista and palpi black; mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color greyish-yellow with four black stripes running along whole length of scutum; propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite orange with black anterior border and broad median dark stripe; second tergite light orange with broad median black stripe and dark brown admedian stripes; third tergite similar but median and admedian stripes narrower. First sternite dark brown, the remaining sternites orange.

In view of the possibility that importation of *M. domestica* into the port of Manila by ships, we felt it would be of interest to compare the Philippine population with *M. domestica* from our laboratory colony in Baltimore. Patton (1923) states that in the male *vicina* the front is about $\frac{1}{7}$ to $\frac{1}{8}$ the width of the eye, while in male *domestica* it is about $\frac{1}{2}$ the width of the eye. In female *vicina* the front is only

* In the description of the abdomen, the fly is held with its head towards the observer.

slightly narrower than in *domestica.* Comparisons were made between the Philippine and Baltimore populations in terms of the ratio of the eye width to width of the front. The results are presented in Table 2 below, which shows that based on the width of the male front, the Philippine population should be assigned to the subspecies *vicina.* It should be noted, however, that the mean of the front to eye ratio was only 1 to 5, which is not as great as that given by Patton for *vicina.* It would be of interest to compare the Manila flies with an isolated *vicina* population from some interior locality; this should give information concerning the possibility that the relatively wide front of the Manila *vicina* is the result of hybridization with imported *domestica.*

TABLE 2.—*Ratio of eye width to front width.*

	Males		Females	
	Philippine	Baltimore	Philippine	Baltimore
Number	116	100	162	100
Range	3.8–6.5	2.7–4.4	0.8–1.5	1.0–1.3
Mean	4.84	3.30	1.14	1.12
S. D.	0.58	0.39	0.12	0.07

Distribution and habits.—This fly is abundant throughout the year especially during the rainy season. It appears to be distributed all over the Islands. Collection record: LUZON, Manila and vicinity, San Marcelino, Los Baños, Legaspi, Baguio; MINDANAO, Luayon; PALAWAN, Puerto Princesa. Most of them came from garbage dumps and human dwellings, but occasionally they may be found on animals. They breed in a wide range of decomposing organic matter of either animal or vegetable origin.

2. MUSCA DOMESTICA (?) NEBULO Fabricius.

Male.—Head: Front about $1/10$ to $1/12$ the eye width; third antennal segment, arista and palpi dark brown. Mentum and labella normal size; prestomal teeth may be slightly visible on pinned specimens. Thorax: Ground color bluish-grey with four black stripes, inner pair extending to anterior border of scutum, outer pair broader and ending as triangular spots in front of suture. Propleura and suprasquamal ridge without hairs. Two pair presutural, 4 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with one hair; vein R_{4+5} without hair

on ventral side beyond radio-medial cross vein. Abdomen: First abdominal tergite brown with brown median stripe and a pair orange spots at both sides of median stripe; second tergite mostly orange due to broad admedian stripes, with a narrow dark brown median stripe expanded at both ends, intervening areas and margins pollinose yellow; third tergite orange with a broad median dark brown stripe and a pair brown admedian stripes, an indistinct band at posterior border. First and fifth sternites dark brown, the others orange.

Distribution and habits.—Only one specimen was taken at Tacloban, Leyte, off vegetation near some carabaos. Other species collected at the same time were *M. bakeri, conducens, craggi,* and *gibsoni.* The identity of this specimen is in doubt as it lacks the propleural setæ characteristic of the subgenus *Musca;* however, because it agrees in other respects with descriptions of *nebulo,* we are provisionally assigning this name to the specimen. The absence of propleural setæ suggests the possibility that this is a new species belonging to another subgenus; on the other hand, rarely a specimen of *M. domestica* from a colony maintained in Baltimore will also lack these setæ. Our specimen may be such an aberrant form of true *nebulo.*

3. MUSCA SORBENS Wiedemann.

Male.—Head: Front about $\frac{1}{7}$ to $\frac{1}{8}$ the eye width; third antennal segment, arista and palpi black; mentum and labella of normal size. Prestomal teeth may or may not be visible on pinned specimens under dissecting scope. The dissected, mounted mouth parts (Plate 2, fig. 6) show 5 pairs of slightly sclerotized teeth which are more or less of equal size with serrated ends; teeth attached directly to prestomal sclerite, dental plate absent. Interdental armature consisting of sclerotized rods split open to receive termination of pseudotracheæ; these rods are slightly longer than teeth and strongly sclerotized at distal ends so that they actually take part in scratching. Prestomal sclerite narrower, shorter than in *vicina,* dorsal free arm not arched; axial apophysis darker, bluntly pointed, directed downwards and a little forwards. Thorax: Ground color grey with 2 broad black stripes that split in front of suture to form a Y; propleura and suprasquamal ridge without hairs. Three pair presutural, 4 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ.

Wing: Dorsal stem of radial vein with 1 sometimes 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: First abdominal tergite dark brown to black; second tergite mostly orange, a broad median dark brown, or black stripe, the margin with a lateral yellow spot; third tergite similar but median and admedian stripes narrower. First sternite dark brown, the others orange. Terminalia (Plate 2, fig. 6): Sclerotized part of phallosome body narrow, waisted and about equal in length to membranous part; posterior process long, narrow and slightly expanded distally.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in two rows; third antennal segment, arista and palpi black; mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color grey with two black stripes slightly narrower than in male, Y-shaped in front of suture; propleura, suprasquamal ridge, and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black or dark brown; second tergite yellow with a broad median black stripe spreading out along anterior and posterior borders to unite with expanded ends of dark admedian stripes to form bands; third tergite yellow with narrower median and admedian stripes, anterior band present. First sternite dark brown, the others orange.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, San Marcelino, Legaspi; MINDANAO, Luayon; PALAWAN, Puerto Princesa, Aborlan. According to Patton (1922) this species is the most important house, bazaar and camp fly. It breeds in a great variety of food-stuffs, in animal and human excrement, and has been described as feeding on discharges coming from eyes, nose of wounds of animals as well as man. In our collections a great percentage was caught in houses and stores. It is abundant in garbage dumps, but very few were taken from animals or their vicinity. This species and *M. d. vicina* are the common house and market flies, and are the most important species of *Musca* causing annoyance to man in the Philippines.

4. MUSCA VETUSTISSIMA Walker.

Male.—Head: Front about $1/12$ to $1/14$ the eye width; third antennal segment, arista and palpi black; mentum and labella of normal size. Prestomal teeth may or may not be

visible on pinned specimens under dissecting scope. The dissected, mounted mouth parts (Plate 2, fig. 8) reveal 5 pairs of prestomal teeth, stronger than those of *sorbens* and waisted before apex, apical margins serrated. Interdental armature consisting of sclerotized rods split open to receive termination of pseudotracheæ. Prestomal sclerite narrow with dorsal free arm slightly arched and strongly sclerotized, axial apophysis somewhat pointed and directed forward and slightly downward. Thorax: Ground color bluish-grey with 2 broad black stripes split before suture to form a Y; propleura and suprasquamal ridge without hairs. Two pair presutural, 2 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 1 or 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: First abdominal tergite black, second tergite light orange with broad median black stripe and orange posterior band; third tergite orange with narrower median stripe and silvery margins. All sternites dark brown. Terminalia (Plate 2, fig. 8): Sclerotized part of phallosome body stout, slightly waisted and equal length to membranous part; posterior process long, stout and expanded distally.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in two rows; third antennal segment and arista dark brown, palpi black; mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color bluish-grey with two broad black stripes split in front of suture to form a Y; propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black; second tergite bluish-grey with broad median black stripe spreading out along anterior and posterior borders to form bands; third tergite similar but median stripe narrower and admedian stripes present. All sternites black.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, Legaspi; PALAWAN, Puerto Princesa. This species appears to be relatively rare in the Philippines. Patton (1923) states that it is a common bush and camp fly, although the collection he examined appeared to include only a few specimens from the Philippines. Seven of our 9 specimens were taken from animal traps or from vegetation near animals, and more extensive collections in rural areas might show a greater prevalence than that indicated by our collections.

5. MUSCA CONDUCENS Walker.

Male.—Head: Front about $\frac{1}{14}$ to $\frac{1}{16}$ the eye width. Third antennal segment, arista and palpi black; mentum normal size but labella smaller. In an uncleared, pinned specimen the teeth are readily visible as dark spines arranged in a circle with the axial apophysis prominently projecting forward. Dissected, mounted mouth parts (Plate 2, fig. 9) show 5 pairs of strong, short, teeth attached to a prominent dental plate. Interdental armature consisting of sclerotized rods that split open to receive termination of the pseudotracheæ. Prestomal sclerite rather short, the part carrying dental plate well arched, axial apophysis long, pointed and directed forwards beyong dental plate. Thorax: Ground color greenish-grey with 4 black stripes, outer pair terminating as triangular spot in front of suture. Propleura and suprasquamal ridge devoid of hairs. Two pair presutural, 3 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 1 sometimes 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: First abdominal tergite black, or dark brown; second tergite yellow with black or dark brown median stripe and incomplete orange band at posterior border; third tergite yellow with narrower median stripe and orange admedian stripes. First and second sternites dark brown, third to fifth sternites orange. Terminalia (Plate 2, fig. 9): Sclerotized part of phallosome body rather slender, slightly waisted and longer than membranous part; posterior process shorter, slender but expanded distally.

Female.—Head: Front about equal in width to eye width. Parafrontal setæ arranged in one row; third antennal segment, arista and palpi black. Mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color greenish-grey with 4 black stripes narrower than in male. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black; second tergite greenish-grey with broad median black stripe spreading out sideways anteriorly and posteriorly to form bands; third tergite similar but with narrower median stripe and bands. Sternites as in male.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, Los Baños, San Pablo, Legaspi and vicinity; LEYTE, Tacloban, Palo; MINDANAO, Luayon. This species was the most

abundant of those associated with animals; rarely an adult may enter houses, especially when animals are kept nearby. This species is hematophagous, and Patton (1923) states that although it is unable to draw blood its well developed prestomal teeth could certainly scratch off a scab or clot of blood. We have observed these flies competing with true biting flies in order to secure blood from wounds produced by the latter.

6. MUSCA VENTROSA Wiedemann.

Female.—Head: Front about equal in width to eye width. Parafrontal setæ arranged in 2 rows; third antennal segment, arista and palpi black. Mentum of normal size but labella rather small. Prestomal teeth not visible in uncleared specimen. The dissected, mounted mouth parts (Plate 2, fig. 11) show 5 pairs of slightly sclerotized teeth with waisted preapical portion and serrated ends; teeth at periphery smaller than 3 at middle which are of equal size. Interdental armature consisting of sclerotized rods that split open to receive termination of pseudotracheæ. Prestomal sclerite and axial apophysis as in *vicina* but slightly smaller. Thorax: Ground color dark bluish-grey with 4 black stripes not distinctly visible. Propleura and suprasquamal ridge devoid of hairs. Two pair presutural, 3 pair postsutural dorsocentral setæ, and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of the radial vein with 1, rarely 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: Very characteristic because of uniform orange color; first sternite dark brown, second to fifth sternites orange.

Distribution and habits.—Our collections contain only a single female, which was taken in a carabao-baited trap at Balara, Quezon City. There were only 2 specimens in the collection examined by Patton (1923); apparently the species is rare in the Philippines. According to Patton and Senior-White (1924) it is hematophagous and is commonly seen about animals. No prestomal teeth were visible in the uncleared specimen, but dissection revealed fairly well developed teeth that should be about as effective as those of *conducens* in scratching.

7. MUSCA PLANICEPS Wiedemann.

Male.—Head: Front about 1/8 to 1/10 the eye width. Third antennal segment, arista and palpi black; mentum normal size but strongly sclerotized, labella rather small. In uncleared specimens the prestomal teeth readily visible, appearing as spike-like structures pressed against labella in a row. The dissected, mounted mouth parts (Plate 3, fig. 12) show 10 pairs of strongly

sclerotized teeth with pointed ends. Teeth attached to a well developed dental plate which extends beyond axial apophysis. Interdental armature consisting of sclerotized rods that split open to receive termination of pseudotracheæ. Prestomal sclerite, especially dorsal free arm, rather short and wide, the part bearing dental plate arched. Axial apophysis somewhat elongated, bluntly pointed and directed forward and downward. Thorax: Ground color light grey with bluish tinge; 4 widely separated black stripes, inner pair starting halfway between posterior border of scutum and suture while outer pair ends as triangular spots in front of suture. Propleura and suprasquamal ridge devoid of hairs. Two pair presutural, 3 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with one hair; vein R_{4+5} without hairs on ventral side beyond radiomedial cross vein. Abdomen; First abdominal tergite yellow with narrow median black stripe and black anterior border; second tergite yellow, a narrow median black stripe with both ends expanded, triangular pair admedian yellow stripes, intervening and marginal areas pollinose yellow, third tergite yellow with narrower median stripe, brownish admedian stripes, intervening and marginal areas pollinose yellow. First sternite light brown, the second to fifth sternites yellow. Terminalia (Plate 3, fig. 12): Sclerotized part of phallosome body rather wide and short, about equal or shorter than membranous part. Posterior process longer, slender and broadly expanded distally but not forked.

Distribution and habits.—The only specimen in our collections was caught from shrubs near a carabao in Gacao, Leyte. According to Patton (1937) this fly is found on cattle and is larviparous in habit, depositing one larva at a time on cow dung. This may explain its rarity. The specimen shows two morphological characters which are of special interest: the absence of hairs on the ventral side of vein R_{4+5} beyond the radio-medial cross vein, and the absence of the forking of the posterior process of the phallosome. These agree with Patton's (1937) description of *Musca planiceps* var. *formosana*. Some authors may consider this as a distinct species.

8. MUSCA CRASSIROSTRIS Stein.

Male.—Head: Front about $^1/_6$ to $^1/_8$ the eye width, third antennal segment and arista black, palpi orange; mentum markedly swollen forming a shiny black bulb at base of proboscis. Labella very much reduced in size, prestomal teeth heavily sclerotized and arranged in circular fashion with axial apophysis

prominently protruding forward. The dissected, mounted mouth parts (Plate 3, fig. 15) show 5 pairs of strongly sclerotized, short, stout teeth, (one usually small); dental plate not readily visible. Interdental armature consisting of two petiolated blades which in turn give rise to other serrated blades. Prestomal sclerite similar to a strong and almost straight rod, at distal end of which are the dental plate and teeth; axial apophysis very prominent, pointed and directed forward beyond teeth; mentum very strongly sclerotized and shaped like a deep spoon. Thorax: Ground color light greenish-grey with 4 black stripes; inner pair becoming distinct about middle of scutum and outer pair in the form of triangular spots in front of suture. Propleura and suprasquamal ridge devoid of hairs. Two pair presutural, 3 pair postsutural dorso–central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 1 or 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial across vein. Abdomen: First abdominal tergite black with yellowish-grey posterior border; second tergite yellowish-grey, an incomplete black, conical median stripe with broad base forming a band; third tergite similar but cone smaller without broad base. All sternites black. Terminalia (Plate 3, fig. 15): Sclerotized part of phallosome body rather narrow and long, longer than membranous part; posterior process shorter, slender and expanded distally.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in 2 rows; third antennal segment and arista black. Mentum, labella, prestonnal sclerite and teeth as in male. Thorax: Ground color light greenish-grey with 4 black stripes. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black but posterior border yellowish with bluish tinge; second tergite greyish orange with incomplete narrow black stripe spearing out sideways anteriorly to form band; third tergite similar except for much shorter incomplete median stripe and narrow anterior band; fourth tergite similar and almost twice length of third tergite. All sternites black.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, Los Baños. Although our records do not show it, the distribution of this fly in the Philippines probably coincides with that of the carabao. This fly is one of the easiest to recognize because of the characteristic bulbous mentum and the incomplete median stripes on the abdomen. All of our specimens

were taken on or in the vicinity of animals, or from animal traps. The species has highly developed blood-sucking mouth parts, and is an important pest of domestic animals. According to Patton (1933) this fly is oviparous and lays its eggs in masses on cow dung. It undoubtedly breeds in carabao dung in the Philippines.

9. MUSCA CRAGGI Patton.

Male.—Head: Front about 1/6 to 1/8 the eye width; third antennal segment, arista and palpi black; mentum normal size, labella relatively small. Prestomal teeth not visible on uncleared specimen. In dissected, mounted mouth parts (Plate 3, fig. 10) 5 pairs of teeth with serrated ends closely resemble those of vicina; no dental plate; interdental armature consisting of slightly sclerotized rods that split open to receive the termination of pseudotracheæ. Prestomal sclerite as in vicina except for its smaller size; axial apophysis bluntly pointed, directed forwards and downwards. Thorax: Ground color dark grey with bluish tinge at anterior border, with 4 black stripes; inner pair becoming narrow anterior to suture. Propleura bare but tympanic tuft present. Two pair presutural, 5 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem or radial vein with 2 hairs; vein R_{4+5} without hairs on ventral side beyond radio-medial cross vein. Abdomen: First abdominal tergite dark brown to black; second tergite orange with broad median brown stripe expanding anteriorly, silvery areas at both sides of median stripe and margins; third tergite orange with narrower median stripe, dark band at posterior margin. All sternites orange. Terminalia (Plate 3, fig. 10): Sclerotized part of phallosome body short and slightly waisted; posterior process markedly curved and widely forked distally.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in a single row; third antennal segment arista and palpi black; mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color dark grey with bluish tinge at anterior border, with 4 black stripes. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite dark brown to black; second tergite dark orange to brown with broad median black stripe spreading out along anterior and posterior borders to form bands, areas at both sides of median stripe and tergal margins yellowish, third tergite similar but median stripe narrower. All sternites orange.

Distribution and habits.—Collection records: LUZON, Quezon City, San Pablo, Laguna; LEYTE, Tacloban. Patton's (1923) collection records include localities in Panay and Palawan. This species appears to be rather uncommon, but it probably is widely distributed in the Islands. All of our specimens were taken on or near carabaos, or from carabao-baited traps. The larval stages are unknown. Since adults are found on animals one would expect them to possess a scratching type of mouth parts, but this was not true of the specimens mounted. There appears to be no mention of the mouth part morphology in the literature. However, the male terminalia corresponds to Patton's (1937) description.

10. MUSCA SENIOR-WHITEI Patton.

Male.—Head: Front narrow, about 1/8 to 1/10 the eye width; third antennal segment, arista and palpi brown. Mentum slightly enlarged and sclerotized, lavella relatively small. Prestomal teeth visible under a dissecting microscope on uncleared specimens. Cleared and dissected mouth parts (Plate 3, fig. 16) show 5 pairs of strongly sclerotized bladelike teeth that appear to be mounted on slightly sclerotized rods which actually comprise the dental plate. The interdental armature consisting of a pair of petiolated blades about the same size as the teeth surrounding the termination of the pseudotracheæ. Prestomal sclerite a strong, almost straight rod at the distal end of which are the sclerotized rods and teeth; dorsal free arm long and narrower than distal end, axial apophysis rounded and heavily sclerotized. Thorax: Ground color dark grey with bluish tinge, with 4 black stripes widely separated; inner pair starting as broad stripes tapering gradually as they proceed towards head, outer pair forming triangular spots anterior to suture. Propleura bare, tympanic tuft present. Two pair presutural, 3 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 2 hairs; vein R_{4+5} with hairs on ventral side extending beyond radio-medial cross vein. Abdomen: First abdominal tergite black, except for 2 yellowish spots at posterior border; second tergite yellowish with broad black median stripe and brown admedian stripes and greyish margins; third tergite similar but median stripe narrower. All sternites black. Terminalia (Plate 3, fig. 16): Sclerotized part of phallosome body short and slender; posterior process rather long, markedly curved and deeply forked.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in single row; third antennal segment, arista and palpi brown; mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color lighter grey with bluish tinge and with 4 black stripes narrower than in male. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black except for 2 bluish-yellow spots at posterior border, a broad median black stripe; second tergite bluish-grey with broad black median and admedian stripes and yellowish margins; third tergite similar except for being more yellowish and narrower median stripe. All sternites black.

Distribution and habits.—This species was first described by Patton in 1922 and was collected from cattle in India. This was not included in the key to Philippine *Musca* prepared by Patton in 1923. Our collections contain 12 specimens taken on or near carabaos or from animal-baited traps in Quezon City and Los Baños. The species appears to be rather rare. Our identification of the specimens is based upon Patton's (1922, 1933) descriptions, and especially through comparison with his illustrations of the mouth parts and male terminalia.

11. MUSCA BAKERI Patton.

Male.—Head: Front about $\frac{1}{12}$ to $\frac{1}{14}$ the eye width; third antennal segment, arista and palpi black; mentum normal size but more sclerotized, labella somewhat reduced. Prestomal teeth readily visible on uncleared specimens as spines arranged in a circle. The dissected mounted mouth parts (Plate 3, fig. 14) show 4 pairs of strong teeth with heavily sclerotized, broad bases. Splitting of the prestomal sclerite into halves may reveal a fifth pair of tiny teeth. Teeth attached to dental plate; interdental armature consisting of petiolated blades surrounding termination of pseudotracheæ. Prestomal sclerite short and narrow; axial apophysis short, bluntly pointed and directed forward. Thorax: Ground color bluish-grey with 4 black stripes, outer pair broader than inner. Propleura bare, suprasquamal ridge with black hairs (parasquamal and tympanic tufts present). Two pair presutural, 4 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 4 sometimes 3 hairs; vein R_{4+5} with hairs on ventral side extending beyond radio-medial cross vein. Abdomen: First abdominal tergite black; second tergite brownish-orange with broad median black stripe spreading out along anterior border

to form an incomplete band, large admedian yellowish areas and small yellowish marginal patches; third tergite yellowish with median black stripe and brownish-orange admedian stripes, yellow marginal patches. All sternites black. Terminalia (Plate 3, fig. 14): Sclerotized part of phallosome body broad and long about equal to length of membranous part; posterior process long, curved, and deeply forked.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in 2 rows; third antennal segment, arista and palpi black. Mentum, labella, prestomal sclerite and teeth as in male. Thorax: Ground color bluish-grey with 4 broad black stripes. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite black with admedian bluish spots; second tergite yellow with median black stripe spreading out along anterior and posterior borders to form bands, triangular admedian stripes fusing with posterior band; third tergite similar but no bands. All sternites black.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, Los Baños; LEYTE, Tacloban; MINDANAO, Luayon; PALAWAN, Aborlan. This fly is hematophagous and was taken only on or near carabaos or in animal traps. It appears to be less abundant than *M. inferior*. Morphological characters that readily differentiate *bakeri* from *inferior* include absence of hairs on lower squamæ, very narrow front of male, black palpi and distinct separation of parasquamal from tympanic tufts in *bakeri;* hairs on squamæ, wide front of male, orange palpi and fusion of parasquamal and tympanic tufts in *inferior*.

12. MUSCA GIBSONI Patton and Cragg.

Male.—Head: Front about $^1/_{14}$ to $^1/_{16}$ the eye width; third antennal segment, arista and palpi black; mentum and lavella normal size. Eyes with fine scattered hairs visible only on high power. Prestomal teeth not usually visible on uncleared specimens, but cleared and dissected mouth parts (Plate 2, fig. 7) show 5 pairs of weak teeth with serrated ends. Teeth attached directly to sclerite, border of each tooth thicker than medial portion; interdental armature consisting of sclerotized rods that split open to receive termination of pseudotracheæ, distal ends of these rods developed and pointed, extending beyond teeth. As in *sorbens*, these rods probably aid teeth in scratching off scab or blood clot. Prestomal sclerite long, narrow, with axial apophysis bluntly pointed, directed downwards and forwards.

Thorax: Ground color bluish-grey with 4 broad stripes; scutellum black in middle, bluish-grey at sides and with black spots at margins. Propleura bare, suprasquamal ridge with black hairs (parasquamal and tympanic tufts present). Two pair presutural, 4 pair postsutural dorso-central setæ, and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 2 or 3 hairs; vein R_{4+5} with hairs on ventral side extending beyond radio-medial cross vein. Abdomen: First abdominal tergite orange or brown with broad median black stripe expanding posteriorly, anterior border black; second tergite with broad median black stripe expanding anteriorly and posteriorly, a pair of broad brown or orange admedian stripes, intervening and marginal areas yellow; third tergite with a narrow median and admedian stripes, intervening and marginal areas yellow and a narrow posterior band. All sternites orange or brown. Terminalia (Plate 2, fig. 7): Sclerotized part of phallosome body short and stout, shorter than membranous part; posterior process long, slender, curved and shallowly forked.

Female.—Head: Front about equal in width to eye width; parafrontal setæ arranged in 2 rows; third antennal segment, arista and palpi black. Eyes, mentum, labella, prestomal sclerite and teeth as in male. Thorax: ground color bluish-grey with 4 broad black stripes. Propleura, suprasquamal ridge and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite brown or dark orange with black anterior and posterior borders, a black median stripe which may be incomplete; second tergite with broad median black stripe spreading out anteriorly to fuse with dark orange anterior band, a pair of triangular admedian black stripes and black posterior band, in addition there are areas with silvery bluish tinge on sides of median stripe and pollinose yellow areas at margins; third tergite similar but median and admedian stripes narrower, and so with posterior band and no anterior band. Sternites as in male.

Distribution and habits.—Collection record: LUZON, Los Baños (Mt. Maquiling); San Pablo, Quezon City; LEYTE, Tacloban, Gacao, Palo. This fly was first found in hills in South India at a height of 6,000 feet by Patton and Cragg (1913). It has never been found in the plains, and according to these authors it causes more annoyance to cattle and horses than do the true biting flies. Like *sorbens* it is unable to break the skin and therefore is dependent on biting flies. Our specimens were taken on or

near carabaos, or in animal-baited traps, with the exception of 2 specimens which were taken resting on tree trunks and shrubs along the side of a road on the slopes of Mt. Maquiling.

Our identification of the Philippine material is based on comparison with the descriptions of Patton and Cragg (1913, 1937). There is no illustration of the mouth parts of this species in Patton's work but the male terminalia are similar to their illustration. In addition the presence of fine scattered hairs on the eyes is said to be distinctive of this species.

13. MUSCA INFERIOR Stein.

Male.—Head: Front about ⅓ to ¼ the eye width; third antennal segment and arista dark brown, palpi orange. Mentum enlarged and strongly sclerotized; labella much reduced in size. Prestomal teeth readily seen in uncleared specimens as a circlet of stout spines with axial apophysis prominently protruding forward. The dissected, mounted mouth parts (Plate 3, fig. 13) show 5 pairs of short, stout and heavily sclerotized teeth. Interdental armature consisting of a pair of petiolated blades surrounding terminations of pseudotracheæ. Prestomal sclerite short and wide, especially that part carrying teeth; axial apophysis long, stout and pointed, directed forward beyond dental plate; mentum long, heavily sclerotized. Thorax: Ground color greyish-blue with 4 black stripes; propleura bare, suprasquamal ridge with hairs (parasquamal and tympanic tufts present); dorsal surface of lower squamæ also with hairs. Two pair presutural dorso-central setæ that are small and difficult to distinguish from surrounding hairs, 2 pair postsutural dorso-central setæ and 1 pair postsutural acrostichal setæ. Wing: Dorsal stem of radial vein with 4 or 5 hairs, vein R_{4+5} with hairs on ventral side extending beyond radio-medial cross vein. Abdomen: First abdominal tergite black or dark brown with posterior greyish-blue spots; second tergite greyish-blue with broad median black stripe spreading out along anterior border forming incomplete band, dark brown admedian stripes with broader posterior end; third tergite similar but median and admedian stripes narrower. All sternites dark brown or black. Terminalia (Plate 3, fig. 13): Sclerotized part of phallosome body short and wide, shorter than membranous part; posterior process long, curved and deeply forked.

Female.—Head: Front about equal to eye width; parafrontal setæ arranged in 3 rows; third antennal segment and arista dark brown, palpi orange. Mentum, labella, prestomal sclerite and

teeth as in male. Thorax: Ground color greyish-blue with 4 black stripes. Propleura, suprasquamal ridge, squamæ and scutal setæ as in male. Wing: As in male. Abdomen: First abdominal tergite entirely black except for a pair of greyish-blue spots at posterior border; second tergite greyish-blue with black median and admedian stripes, a black anterior band; third tergite similar but stripes and anterior band narrower. All sternites dark brown or black.

Distribution and habits.—Collection records: LUZON, Manila and vicinity, Los Baños; LEYTE, Gacao, Palo. This species is relatively abundant, and is usually found in association with animals, especially carabaos. One specimen was captured near a store, and another from the porch of the junior author's residence on the Diliman (University of the Philippines) campus. Both specimens probably had followed carabaos, which frequently passed close by the store and house. The species is an efficient blood-sucker. Patton (1923) suggests that the females are larviparous. The junior author found distinctive, stalked eggs on dissection of gravid females, which suggests that the species is oviparous. The stalk on one end of the egg may serve as a means of maintaining the egg in a proper position in or on the surface of fresh carabao dung. As noted above, these females also contained fresh fecal material in their guts.

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ILLUSTRATIONS

Plate 1

Fig. 1. Thorax of *Musca vicina* showing the following structures: PP, propleuron, with setæ; MSP, mesopleuron; STP, sternopleuron; HYP, hypopleuron; US, upper squama; SR, supra-squamal ridge; LS, lower squama.

2. Posterior portion of thorax showing the following structures: WB, wing base; PT, parasquamal tuft; SR, suprasquamal ridge; TT, tympanic tuft; LS, lower squama. The upper squama has been detached to expose the tympanic tuft.

3. Mouth parts of *Musca inferior* showing the following structures: LE, labrum-epipharynx; LG, labial gutter; PS, prestomal sclerite; T, teeth; AA, axial apophysis; L, labella; PTM, pseudotracheal membrane; F, furca; M, mentum.

4. Prestomal sclerite of *Musca sorbens* showing the following structures; DFA, dorsal free arm; PS, prestomal sclerite; AA, axial apophysis; IDA, interdental armature; T, teeth; PTR, pseudotracheal ring.

5. *Musca domestica vicina* showing prestomal sclerite and phallosome.

Plate 2

[Prestomal sclerites and phallosomes.]

Fig. 6. *Musca sorbens.*

7. *Musca gibsoni.*

8. *Musca vetustissima.*

9. *Musca conducens.*

10. *Musca craggi.*

11. *Musca ventrosa* prestomal sclerite only.

Plate 3

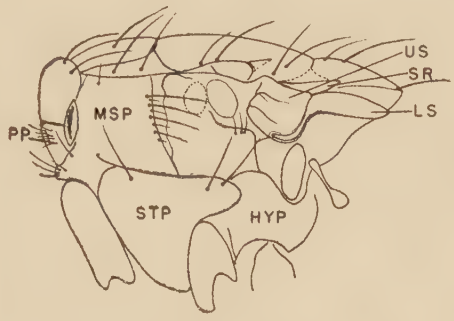
Fig. 12. *Musca planiceps* showing teeth of one-half prestomal sclerite and phallosome.

13. *Musca inferior.*

14. *Musca bakeri.*

15. *Musca crassirostris.*

16. *Musca senior-whitei.*



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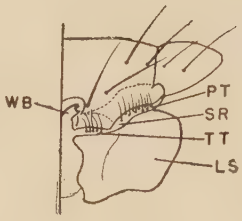

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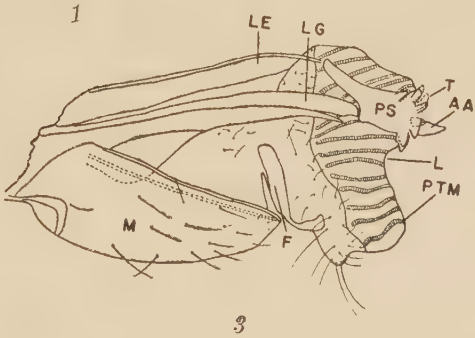

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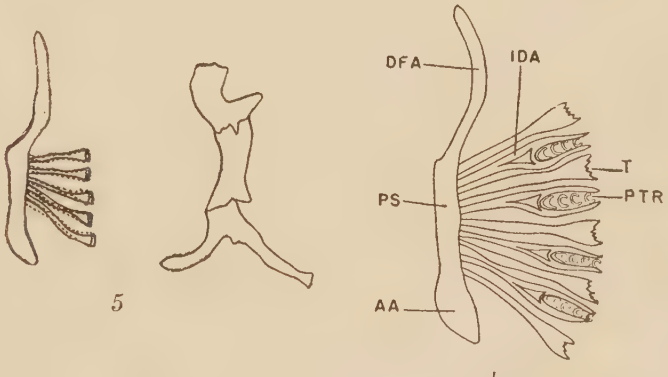

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PLATE 1.

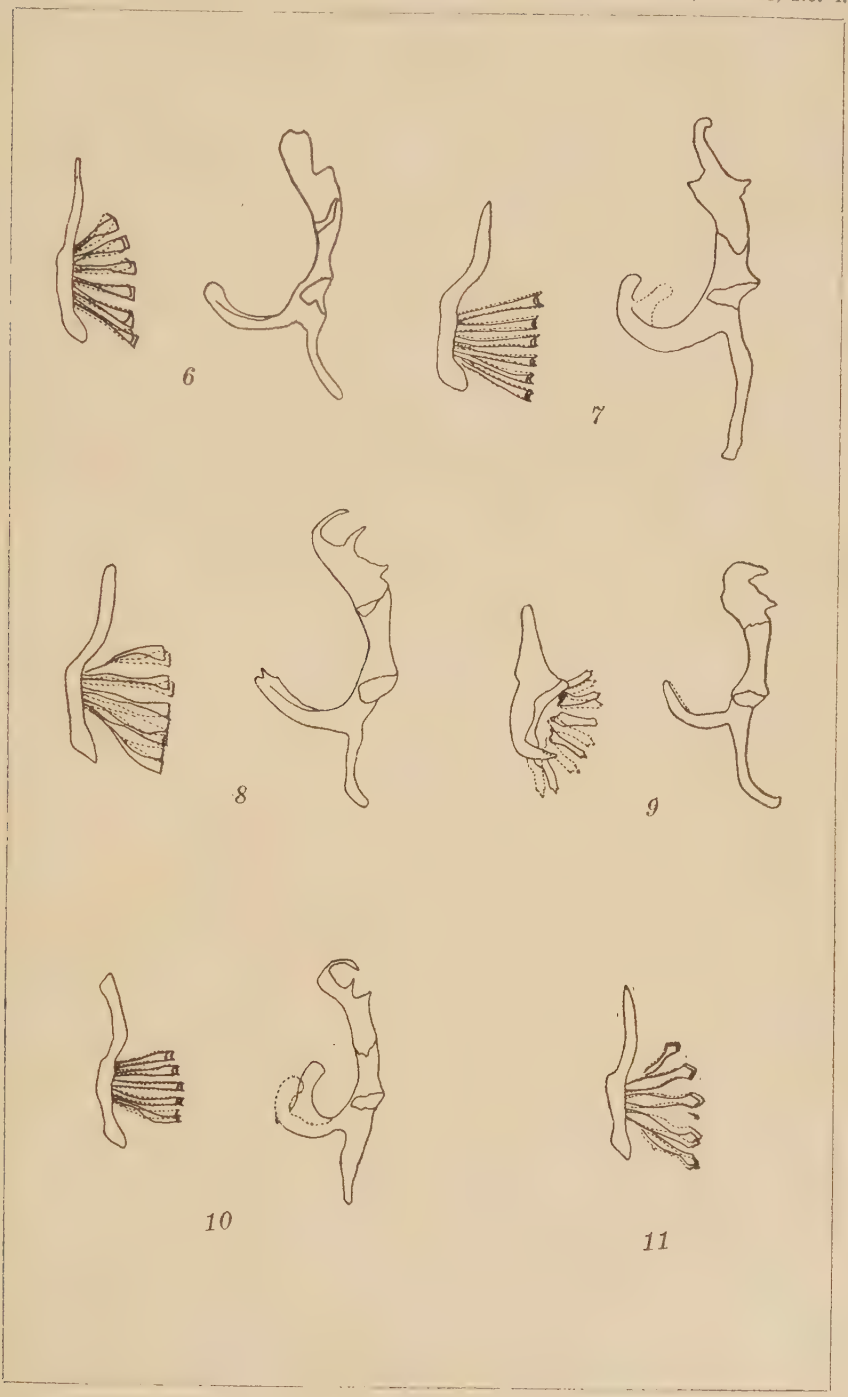

PLATE 2.

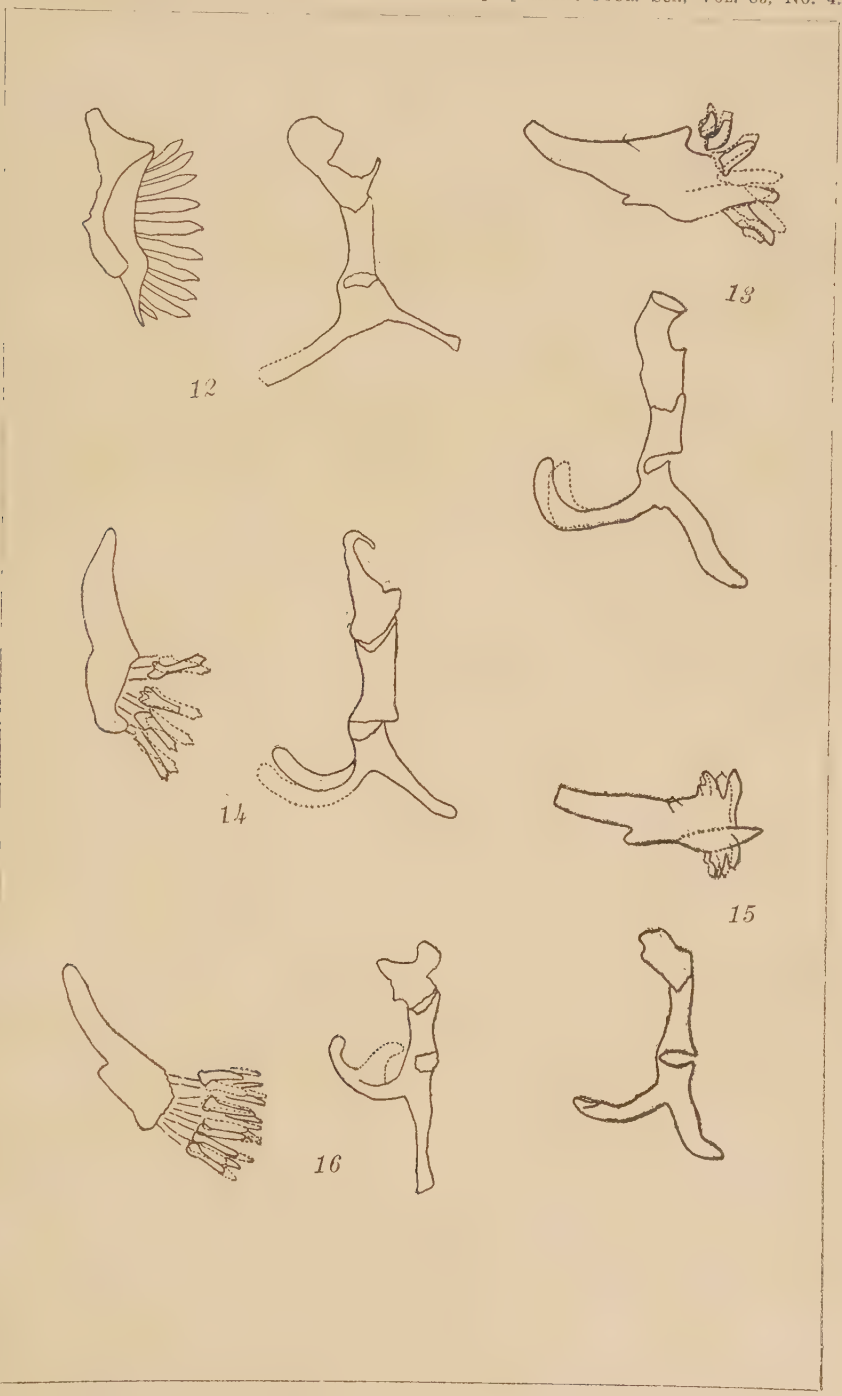

PLATE 3.

WITCHES AND WITCHCRAFT IN LEYTE AND SAMAR ISLANDS, PHILIPPINES

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INTRODUCTION

The Bisayan Islands are in Philippine folk belief the home of witches. Whatever led to this "distinction," the investigation showed that belief in witches and witchcraft is common to all segments of the population in the barrios as well as in the towns of Leyte and Samar. Even many intellectuals have this belief, and the fear of witches and witchcraft is common.

The data in this study collected from different barrios and towns in Leyte and Samar show a definite pattern of belief. Through field trips, interviews and reports this general pattern has been established. Interesting stories had to be put aside to shorten the report; only the characteristic elements have been listed. No attempt is made to solve inconsistencies resulting from different reports and interviews, as inconsistency seems to be the privilege of these folk beliefs. Nevertheless, the variations are minor; far more impressive is the unity, even in details, in belief in the area concerned. This uniformity of belief even among the remotest barrios on the two islands suggests an origin from an earlier culture. Comparative studies from Indonesia and Indo-China may shed more light on the matter.

The lack of competent literature in the provinces, travel restrictions imposed by the author's occupation, and lack of funds made comparison impossible even among the other Bisayan Islands. Whatever meager information is available from these islands (Negros, Cebu, Bohol, Panay), however, confirms the same pattern of belief and makes it, therefore, probable that this study is representative for the Bisayan Islands in general.

CONCEPT

In *waray-waray* (the dialect spoken in Samar and Eastern Leyte), a witch is called *aswang*.[1] In Hilongos, Leyte, where Cebuano is spoken, the term *aswang* refers not only to the witch proper but also to a whole group of ghostlike beings.

[1] In the English language, the witch is generally taken as a female. The reader should keep in mind that in this report the witch is either a male or a female.

1. *Agtas,* which are short and small beings with big, white eyes, are said to live in mangrooves and other swampy places. They are always seen laughing and sometimes smoking a little pipe and leaning on the trunks of small trees growing in such places.

2. *Phantasmas,* who are big and tall "madres" [2] or "padres" [3] with white clothing, appear usually just at the beginning of darkness and on midnights when the moon is bright. They do not live in a particular place and are believed to appear and vanish into thin air. They are always seen walking in streets and small trails leading to interior barrios when these are deserted. They wear a wistful look and a far-away glance. When someone meets a *phantasma* it is believed that the *phantasma* will do no harm if the person stays at the roadside and does not block the way. He must not meet the *phantasma* or pass him by. Most often a "padre" phantasma appears to a girl and a "madre" phantasma, to a boy.

3. *Ungos* and *bawos* are big and muscular men dressed only with a loin cloth. The children "see" them smoking the biggest pipes and sitting on the branches of big trees called *nunok* [4] which are their permanent homes. At daytime the *ungos* and *bawos* are not seen; but the people acknowledge the presence of one or a group of them because they play jokes and, when disturbed, get angry. When they play jokes they either give a person one big *latik* (a quick and sudden touch with the forefingers) on the head or steal the latter's firewood, basket or clothing. When they get angry, they are so powerful that they could cause serious sickness which even the *tambalan* [5] cannot cure. Only very few adults who know a certain *oracion* [6] may go near or under the big trees which the *ungos* and *bawos* inhabit, or attempt to cut their branches.

[2] and [3] Literally translated from the Spanish as "mothers" and "fathers" respectively. In the native concept, terms are applied to nuns and priests, loosely to members of religious sisterhoods and brotherhoods.

[4] Meaning any spirit tree in Cebu Bisayan, but, particularly *Ficus payapa* Blanco: in *waray-waray* dialect it refers to the *dalakit* tree (*Gyrinopsis cumingiana* Decne).

[5] A native medicine man or shaman; from *tambal* meaning to cure. The *tambalan* uses partly herbs and saliva to cure the sick, in which superstition enters in the process especially if, according to folk belief, an evil spirit cause at the sickness. The *tambalan* has, in folk belief, the power to check the influence of the evil spirit.

[6] A prayer with magic power.

4. *Sigbens*, are goatlike animals, are hornless, and have big, wide and prominent ears. They appear and are seen only in the evening; they are invisible during the day. In the evening they stay under the house of a dying person. The come back for nine consecutive nights, until the accustomed *novena* for the dead is over. Their bodies produce a very pungent and nauseating odor and their big ears clap like two pairs of hands at the sides of their heads.

5. *Ugkoys* live in fresh-water and are usually seen in rivers during floods. Their favorite hobby is dragging down their victims by the feet deep into the bottom.

6. *Santelmos* are the souls of those who drowned in shipwrecks and storms. They live in the sea. They seldom appear in shallow waters or on river banks. They like the deep sea better, because they can easily get their victim when it is alone. The fishermen who fish at night and do not return the following morning are said to be victim of the *santelmos*. The *santelmos* rise to the surface of the sea during rainy days. Even deep down at the bottom of the sea they can be seen, because their bodies are said to be luminous.

7. *Abats* and *awoks* are the most dangerous being who "really" strike and do harm to man. They have only the upper parts of their bodies. They have big, red, bulging and hungry eyes, disheveled hair and long bony and clawed fingers. They can fly with only their heads and hands. Their favorite food is small children. They are active only at night and can travel long distances. The *abats* of neighboring towns can visit other towns. They fly over nipa houses wherein lives a pregnant woman.

The *abats* and *awoks* have qualities which in Samar and Eastern Leyte are attributed to the witch. The difference between a witch and other ghostlike beings mentioned above is that the witch belongs to the human race and is only possessed by an evil spirit, whereas ghostlike beings are not humans, although some of their habits are like those of humans.

In Samar–Leyte folk belief the witches are human beings possessed by an evil spirit and with magic powers. They are grouped into (*1*) the flying witch (*malupad*) and (*2*) the walking witch (*malakat*).

The *malupad* or flying witch, also popularly called "night pilot" flies generally during midnight and causes a noise like that of

the *wak-wak bird*.[7] Another name for the flying witch is therefore *wak-wak*. The *wak-wak* bird accompanies the witch in her flight. The bird sits on the roof of a house where someone is sick or a pregnant mother is about to give birth. The witch goes under the house and brings harm to the sick person or to the newborn baby by sucking its blood and eating its liver.

The walking witch (*malakat*) goes out at night or even at daytime and hides in secluded places. In attacking a person she assumes a horrible and frightful sight. Her long hair spreads all over her face. Her eyes turn fiery and her saliva flows out from her mouth like long strings. Her nails grow long and sharp. As the fight begins her hair crawls into the person's nose, ears, mouth and eyes, depriving him of his breath, voice and sight. She grips the victim firmly on the arms and legs. With her sharp claws, she digs into the victim's skin until he bleeds. If the witch has a weapon with her, she avoids the struggle and the victim might be killed; thereafter the witch feasts on the victim's blood and flesh.[8]

ORIGIN OF WITCHES

The origin of witches has been forgotten by the people; at least the writer could not establish a common pattern for the area covered. An informant [9] said only "since time immemorial the witches have been on earth."

It seems that the "cave spirits" also called "spirits of the mountains" made the first witches. At least this is the belief in Abuyog, Leyte. It is said that during Lent the caves—the homes of spirits—are opened to be entered only by those who know the magic words (*oracion*). In the caves are bottles with plants. If someone finds a bottle in which a plant is growing naturally, that is with roots down and leaves up, he will become a good quack doctor; but if he finds a bottle with an inverted plant, he will automatically become a witch (*aswang*).[10]

[7] A 105-year old resident from barrio Tigbao, Tacloban, Leyte, gave the following description of the *wak-wak* bird: "It is as big as a turkey with the beak like that of a parrot and the face similar to a human being. It has long claws. It lays its eggs in the *cogon* field. It flies only at night." Careful investigation assured the writer that the *wak-wak* bird is a kind of an owl. Bird and witch are in folk belief sometimes identified.

[8] Belief in Maripipi Island, north of Leyte.

[9] From Maripipi Island.

[10] An informant from Abuyog, Leyte.

The folk belief is more concerned on how witches come into being today. Two explanations seem to prevail: namely, by inheritance and by physical contact with a witch.

At the deathbed of a bewitched family member, one can become a witch through inheritance. Witchcraft in the family is transmitted to the member best fitted to inherit the power. Inheritance is not through birth, therefore, but by transmission. If, for example, the father were a witch and dies, the power is given to the mother; after her death, it is given to the eldest son or daugther.[11] Thus, not all members of a family are witches.

One way to become a witch by physical contact with another is through food and drinks. The witched person places a germ in the food or drink of her victim, the witch being in human form in doing this. In the stomach the germ develops into a small monster of the size of a bird. As soon as the monster has fully developed, the newly bewitched person becomes strongly imaginative and feels an urge to suck fresh blood from warm-blooded animals including human beings. If hungry, she sees things not as a normal person sees them. In the egg, for example, she sees the unhatched chicken; in a pregnant woman, she sees the fetus. At this moment a strong urge develops to feast on these living things. To satisfy her craving she flies at night to the house of a pregnant woman or sick person to suck their blood; or she transforms into an animal[12] for the same purpose.[13] Witchcraft is also transmitted through touch by a witch on an intended victim. To counteract the spell, the victim has only one remedy; namely, to touch the witch quickly in return.[14]

A witch can also transmit her power with her breath.[15] She blows on the victim's *alimpoporo*.[16]

Presence at the agony of a dying witch is another occasion for one to become a witch. Shortly before the last breath of the dying witch, the monster in her stomach leaves her body to look

[11] Belief in the towns of Tabon-Tabon, Abuyog, Alang-alang, Leyte.

[12] The belief in Giporlos, Samar, is that the witch takes the form of the animal which was incubated inside her.

[13] An informant from Carigara, Leyte.

[14] An informant from Giporlos, Samar; same belief exists in Burauen, Leyte.

[15] An informant from Burauen, Leyte.

[16] Area of the head where the tonsure is placed; informant was from Tigbao, Tacloban, Leyte.

for a new habitat. It enters another and if it finds the person a satisfactory habitat, the person for "certain" will become a witch. If not, the person will become paler and paler and finally die.[17]

A witch develops in stages: First, the germ incubates in the stomach. At this stage the newly bewitched person has often stomach aches called *sorok-sorok*.[18] The person feels uneasy during the day, but is very active at night. In this stage, the bewitched[19] can easily be treated by a *tambalan*. Second, after about a month of suffering from *sorok-sorok*, the person develops an appetite for raw chicken. As soon as the person sees a chicken, his saliva starts flowing. Third, the witch teaches her victim how to fly and how to go to sick persons or pregnant women especially at the backyard, or under the house of the sick person, since he or she is not yet an expert in flying and escaping. This is also the time to detect a newly bewitched person. At this period the "disease"[20] can hardly be cured. Fourth, in the fourth stage the person becomes an expert *wak-wak* and can no longer be cured. If she submits herself to a *tambalan* for a cure, she will die.

OUTWARD APPEARANCE

It seems remarkable how the description of a witch could point to a standardized pattern in spite of the many variations in details arising from the fertile imagination and fondness for tall stories of the people. There is a general agreement that the witch in ordinary life is a rather acceptable and normal person.[21] She changes at night-time, or sometimes during the daytime when she comes under the magic spell; i.e., when she gets hungry and has the craving for blood and human flesh. Then her eyes glow reddish, becoming sharp and penetrating, enabling her to see through a pregnant mother and see the child in her womb.[22] Her teeth become sharp and her fingernails, long and pointed like swords, fit tools to use and feast

[17] Same informant from Giporlos, Samar; same belief found in Balangiga, Samar.

[18] *Sorok-sorok* is a part of the stomach (plexus).

[19] To be bewitched in Leyte and Samar is looked at as contracting a contagious disease.

[20] Belief in Balangiga, Samar and in Tabon-Tabon, Leyte; two different informants giving the same belief.

[21] An informant from Alang-alang, Leyte.

[22] An informant from Dulag, Leyte.

on the blood and flesh of the sick, on newborn babies, and on the corpses of the newly buried in the cemetery.

Her hair is brittle, straight and spreading, giving the witch a wild and furious look. Saliva drips from her mouth when she is prowling for prey. Her body is thin and slippery, making it possible for her to fly or crawl through the smallest opening. "The witch in action" (*napoo*) is a devilish sight.[23]

HABITS OF THE WITCH

The witch, according to one report,[24] has a big jar. Every night she crawls head first into the jar and stays there in a vertical position. In this position, the witch hears the moaning of sick persons within a wide radius. She determines her victim and flies to her destination. There she goes under the house and is transformed into the animal, previously incubated in her, which may be a dog, a cat, a pig, and others. After she has sucked the blood of the sick person and has eaten some of his inner parts such as his liver and intestines, she goes home and feeds her pet animals.

Informants from Leyte and Samar have the same description of the flying habit of a witch. The witch ordinarily flies at midnight. Before her flight she applies magic oil under her armpits. This makes her wings to grow instantly. She detaches her upper part (head, shoulders, and hands) from the lower part (waist below). With only her upper part, she flies away, leaving her lower part in a certain position. Should someone alter this position while the witch is away, the witch would not be able to unite the parts anymore and she would die. In flying, the witch is accompanied by the *wak-wak* bird and is therefore called *wak-wak* herself.

Their carnivorous habit is the outstanding characteristics of witches. They prefer the blood of sick persons and pregnant women. Before sucking their victims, they dance the "mambo-tambo" while laughing.[25]

To them, the flesh of infants and their livers especially are a delicacy; therefore witches like to be midwives.[26] They steal

[23] This descriptive pattern has been verified from informants from the towns of Abuyog, Dagami, La Paz, Tacloban, Tabon-Tabon, Hilongos, Leyte; and from informants from other places in Samar.

[24] Of an informant from Giporlos, Samar.

[25] An informant from Tacloban, Leyte.

[26] Another informant from Tacloban, Leyte.

newborn babies and substitute banana trunks for the stolen babies.[27]

Witches often visit cemeteries to watch for new burials and to feast on the bodies. Their long fingernails and sharp teeth make them especially fit for this purpose.

They live in houses whose tops have no roofs and whose floors are not all nailed, in order to facilitate going out readily. They do not molest their immediate neighbors, but prefer to practice their evil powers in far-away places to keep their secrets from their neighbors.[28]

THE POWERS OF THE WITCH

A witch has many powers, among which the power to transform herself is the most common and important. In the pursuit of a prey she can take the form of any animal of her choice, preferably of one which was incubated in her at the time of becoming a witch. The form of a dog, a cat, or a pig is her most common choice. This transformation, called *salipdanan,* a kind of camouflage, means taking cover.

If a witch is wounded while in the form of an animal, the wounds inflicted to the animal appear later in the bewitched person.[29] A witch heals her wounds with her sticky saliva.[30]

The power to fly, to harm other persons, and to transmit their power or bewitch other persons have been mentioned already earlier in this report.

In some places,[31] witches are ascribed the power of *barang.* This is the power to inflict harm on others. Because *barang* is mostly connected with evil effects, this power has been attributed to witches.[32] It is said that this power was originally transmitted by cave or mountain spirits and fairies. Nowadays it is transmitted from one to another by means of *tahas.*[33] Only brave and strong-willed person can acquire this power. Bravery is shown by one wishing to become a *barangan* (one with the barang power) by going at night to the cemetery to the dead, or going to the church when the clock strikes 12 at midnight. It is said, that in undergoing the *tahas* process, if one does not

[27] An Abuyong, Leyte, informant.
[28] Source from Tigbao, Tacloban, Leyte.
[29] Source from Babatngon, Leyte
[30] Source from Abuyog and Tacloban, Leyte.
[31] Guiuan, Samar; Borongan, Samar; Abuyog, Leyte.
[32] Tambalan also possess this power.
[33] "To give more power".

continue because of lack of bravery, he will go crazy. For this reason, so few are believed to have the power.

The advantage of one possessing the power of *barang* is his ability to cure sickness caused by fairies and evil spirits. The *barangan* in this way becomes a witchdoctor.

In folk belief the *barangan* has the ability to kill anyone by mere words of the so-called *oracion.* The *barangan* may also cause deformation of the body; the person afflicted loses either his nose or another part of his face. [34]

Persons who wish to harm their enemies quite often secure the help of a *barangan* who wish his power can cause the desired harm. [35] It is also the folk belief that a full-fledged *barangan* has a whole supply of "invisible destroyers," in the form of germs and insects, which can be sent to the intended victims. A protection against this "barang power" is the wearing of gold or of a bullet. This makes a person invulnerable. As mentioned before the *barangan* is not necessarily a witch, but witches have the "barang power."

Other powers of the witch are connected with her power of transformation: she can make her weight so light that she can easily sit on the twig of a tree; she can go through the smallest holes.[36] Upon application of the magic oil which she keeps to herself, she becomes very strong, slippery, fast and almost invisible.[37]

She has also a keen sense of smell, with which, from a far distance, she discerns approaching people; through it, she finds those who are sick.[38] A witch can smell the sick and the dead anywhere however far. Both the sick and the dead have a sweet smell to the witch. [39] Her eyesight becomes extremely keen specially at night.

[34] Many parts of Samar and Leyte were affected before World War II by yaws (Frambesia). People affected had deformed faces, and ascribed the disease to be caused by *barang.* A United Nations medical team wiped out the disease after the war.

[35] Samar is famous as having many *barangan.* If someone in Biliran Island hates a neighbor, he goes to Talalora, Samar, to engage a *barangan* to harm the neighbor.

[36] Informant from Alang-alang, Leyte and from Piporlos, Samar.

[37] From a Tigbao, Tacloban, Leyte, source.

[38] Source from Alang-alang, Leyte, same as in Footnote 34.

[39] Based from chief barang informants from Abuyog, Leyte; Guiuan and Borongan, Samar.

PROTECTION AGAINST WITCHCRAFT

A witch is highly feared throughout Leyte and Samar. To counteract her magic power, one may adopt natural precautionary measures or use magic antidotes or charms.

If a person is sick or a woman is about to give birth, one measure to guard the house against a witch is to place sharp swords (bolos) between the bamboo floor with the sharp edge down, so that the witch will cut her back or wings if she crawls under the house.[40] Sometimes pointed sharp bamboos are used for the same purpose.[41] In other places a *sogub* a spearlike weapon, is placed near the house to scare the witch. [42]

Sick people should not stay in houses with big holes; their beds especially should not be near such holes, because it is through these holes that witches gain entrance with their slippery bodies. [43] Sick people are further admonished to abstain as much as possible from groaning and moaning, so as not to attract by these sounds the attention of the witches who are only too willing to pay them a visit at night. [44]

Out of fear for witches, in general everyone is careful not to offend them; therefore people believed to be witches are treated with care and politeness. In Caibiran, Leyte, politeness goes so far that people, in throwing garbage out of the window late at night, say to the witches: "Stay away from there as I am blind" (*Tabi kamo dida buta ako*) : It is believed that if one does not utter these words before throwing the garbage, he will be punished by the witches.[45]

Just as the witches use oil to grow wings and make them fit for their devilish tasks, so people, in folk belief, use a sacred oil as a protection and antidote (charm) against witchcraft. This oil is manufactured with great care and accompanied with solemn prayers. A slight error in the making of the oil will make it powerless. The oil is made from a selected coconut tree. The best fruit is picked after long observation and at a prescribed time which is at twilight and during a weather that suggests loneliness, with the sea breeze having a chilling touch, and the moon shining like a perfect marble ball.

[40] and [41] Source from Giporlos, Samar.
[42] From a La Paz, Leyte, informant.
[43] Informant from Alang-alang, Leyte.
[44] Same informant as in Footnote 42.
[45] Informant from Caibiran, Leyte.

After picking the fruit, the oil is prepared in the usual way: The coconut is grated, the milk is squeezed out and then boiled till the oil is produced. In making the holy oil only firewood gathered from high mountains is used. During the process of making the oil, prayers are said with sincerity and solemnity. After processing the oil for hours, the by-products are thrown into the ocean to avoid the witch in finding traces of the one who made the sacred oil. The oil is powerful and effective in making the witch uneasy and unable to do harm to its holder.

The following story was told by an informant:[46] Years ago my grandfather married accidentally a witch. When he felt symptoms of witchcraft in himself, he made the sacred oil and gave it to his grandchildren to protect them from harm by his bewitched wife. He knew that the best way to become a witch was through physical contact and by eating the food prepared by the witch. Since the grandchildren came often to the house and ate the food prepared by the bewitched grandmother, the oil was needed for their protection. Such food used to transmit witchcraft is prepared from a green leafy vegetable called *gaway* (*gabe?*).[47] One time when they were getting ready for dinner, my father changed the seating arrangement to be sure that he would be sitting next to grandfather who lately showed more and more signs of being bewitched. My father pretended to be late and could take the seat next to grandfather. In his pocket he carried the sacred oil. Very soon grandfather felt rather uneasy. Abruptly he left the table and went away and did not come back until the next day. To my father, this was a sure sign that grandfather was bewitched. It is common belief that the one who has the sacred oil will not be harmed by witches.

A simpler protection against witches is the use of table salt which is readily available, unlike the holy oil which is only known to experts. It is said that witches are allergic to salt both in its liquid and solid form. Salt ground with garlic and ginger is an even more powerful compound dreaded by

[46] From Babatngon, Leyte.

[47] Exact identity not known. Quisumbing gives *gauai-gauai* (in Samar–Leyte Bisayan) for *Sagittaria sagittaefolia* Linn, an aquatic plant producing tubers which are edible. This plant is different from *gabe* [*Colocasia esculentum* (Linn.) Schott.], which the people are inclined to identify with the former. *See* Quisumbing, Eduardo. Medicinal plants of the Philippines (Manila, 1951) 82 and 141.

witches because of its pungent and sharp odor which is said to be fatal to their olfactory sense.[48]

Burning rubber also drives witches away, because of its hurting smell.[49] A 105-year-old woman from Tigbao, Leyte, gave the following advice: "Use *balangue* or *tikoko* for firewood. Put any thing that is scratchy (*magirhang*) in a bottle of oil and bring it along. Put also the same in a cloth bag and hang it on the neck, carrying it along everywhere."[50]

HOW TO DETECT A WITCH

Before one can protect himself against the evildoings of a witch, one must know to recognize her. A number of devices are known. The *wak-wak* and *ki-kik* cry of the night birds make everyone in Leyte and Samar alert. It is believed that a witch is around in the neigborhood when these sounds are heard. Unknown persons or animals found under the house following the same are suspected to be witches.[51]

A witch may also be recognized as follows: If someone is a witch suspect and is met at daytime, look at her straight in the eyes. A witch will avoid you as she cannot look straight in your eyes.[52] On certain days: namely, Friday and the days of Lent, the image of an object in the eyeball of a witch is inverted. This is, according to the old people, a sure way of recognizing a witch at daytime.[53]

The holy oil mentioned above plays also a role in detecting the witch. A similar kind of oil is produced from a one-eyed coconut obtained on Holy Fridays. This oil placed in a bottle will start boiling in the presence of a witch; it is therefore a sure way to detect her.[54] A member of a family suspected to be a witch, if asleep, is turned to another position. If the person is a witch, she will not wake up anymore, because her spirit would not be able to find its way back into its body.[55]

A person fond of eating raw chicken is also highly suspected to be a witch.[56]

[48] Informant from Tacloban, Leyte.
[49] From a Dagami, Leyte, source.
[50] Same informant as in Footnote 37.
[51] and [52] Same informant from Carigara and Tacloban, Leyte.
[53] Informant from Abuyog, Leyte, and from Guiuan, Samar.
[54] From Tacloban and La Paz, Leyte.
[55] From informant from Balangiga, Samar.
[56] A Guiuan, Samar, source gave this information.

HOW TO KILL A WITCH

No statistics are available of those killed on suspicion of being witches. But in distant barrios where strict enforcement of the law is not possible, witch killing still goes on.[57] One informant said: "The *aswangs* in my home do not live long, because all the people are after their necks." [58] Another said: "In our place we have still one witch, the rest having been killed or having moved to far-away places where they are not known." [59]

Certain methods to kill a witch for sure are known in folk belief. An informant from Carigara said: "To kill a witch is quite hard, for the older the witch the stronger she becomes. As soon as you have deadly wounded a witch, plant your dagger into the ground, and the witch will not survive. If you do not do this, the witch will apply her oil to her wounds as soon as you have left her, and she will be healed."

Another informant from Carigara said that the best way to kill a witch is to use not a gun, but a sharp pointed bamboo. The witch should be stabbed with this on the back and her body slashed to pieces. One should also recite certain prayers (*oracion*), because the prayers render the witch helpless and paralyzed. [60]

If the witch appears in the form of an animal, the people of La Paz, Leyte, say that one should strike the animal at the tail, since the witch is holding its tail. If the tail is hit, the witch will become visible in her human form and can be killed. [61]

The people of Balangiga, Samar, say that to stab and to slash a witch who appears in the form of an animal is useless, unless the animal is cut into two pieces and the two pieces are brought to opposite parts of a river. In this way, the witch cannot unite the parts anymore and will die the following morning. If the parts are not separated, the witch applies some leaves to the wounds, says some words, and is healed.

A WITCH IN SOCIETY

The social life and reputation of a witch in society is complicated. Besides being feared, a witch is the most detested, hated and disrespected person, in spite of some good character

[57] Casual newspaper reports confirm this.

[58] By a Carigara, Leyte, informant.

[59] From a Dagami, Leyte, source.

[60] Informant also from Carigara, Leyte.

[61] From a La Paz, Leyte, informant.

traits which are believed to be a cover-up for her inhuman behavior.

In Alang-alang, Leyte, the people say that "witches are respected because we fear them; as human beings, they are also respected because they are quiet and reserved. They do not go to social gatherings unless they are invited. They are very friendly, if you are also good to them; they are the most hospitable people. They indulge in a little alcoholic drink. You cannot hear them quarrel with other people, unless of course they are provoked. They are diligent and industrious in manual labor, and attend to their work seriously. They are somewhat individualistic and have self-reliance. They prefer not to seek advice from other people. They seldom complain when assigned to work. If they refuse to do a thing, however, one should be understanding not to insist in its performance.

In Dagami, Leyte, the good traits of witches are also explained as a cover-up. An informant said: "During the day the witches are like us. They participate in social activities, they are devout Catholics, and they attend Mass everyday and receive Holy Communion. But we already know that they are only pretending, so that they will not be suspected."

The life of a witch and her family is made difficult by constant suspicion of the people. She is shunned and sometimes openly embarrassed. Food and delicacies sent from her kitchen out of hospitality are thrown away by others or are fed to the dogs. Endless gossips circulate about her horrible and inhuman ways such as feasting over a dead man's body which someone would claim to have seen the night before. Her family members receive many sarcastic and cutting remarks. [62] Her pretty daughters stay unmarried, because young men are afraid to marry them. [63]

People would like to become witches for the simple reason that "witches can enjoy everything precious in life. They can make many and long trips without being noticed and paying any amount, because they fly on their own power. They can see movies, carnivals and costly stage shows; they can get all the luxuries of life, since, because of their power, they can take jewelries from the stores and money in any amount from the bank." [64] But few people want these privileges, because to be

[62] From a Guiuan, Samar, informant.
[63] Source from Tacloban, Leyte.
[64] From an Alan-alang, Leyte, source.

a witch is too risky. A big landowner in Biliran Island whose tenant was bitten by a dog in his premises and died a few days later, was secretly called a witch since that time. He had to build a high wall around his house and could not leave it without protection.[65] Hence, it is still very dangerous to be called a witch in Leyte and Samar, because "the people are after their necks."

CONCLUSION

Folk belief in witches and witchcraft in the Eastern Bisayas conforms to a standardized pattern that finds similarity even among the remotest barrios of North-East Samar and South-West Leyte that have hardly any economic and social contact. This striking feature leads one to assume the belief to have its roots in a common Southeast Asian culture.

Comparative studies should be made to determine these mutually related elements for Southeast Asia. Some beliefs are world-wide; for example, that witches change into animals and if wounded the wounds appear in the body of the witch; that they fly and eat human flesh. Other elements are of Christian origin; but one should be careful not to attribute to Christian influence what might belong to an earlier culture assimilated by Christian culture. For example, is the use of "holy oil" as a protection against witchcraft of Christian origin? The fact that it is prepared on Holy Friday points to a definitely Christian influence; but the use of oil for such occasions might have been in practice long before Christianity came. Again, is the use of salt also to be attributed to Christian practice in the exorcism during the baptismal ceremony, or is it also found in other areas of Southeast Asia where the native culture remains unaffected by Christianity? Comparative studies on the subject may solve these and similar problems.

Folk belief in witches and witchcraft has its stronghold in the barrios from where it finds its way to the towns and cities through housemaids and visiting relatives who regale children with their horrible stories about ghosts and other beings which form the motifs of said belief.

[65] To avoid possible embarrassment to his various informants and upon requests of some of them, author has deemed it best to give only the residences but not their names in this and previous footnotes.

PHILIPPINE LEPTOPODIDÆ (HEMIPTERA)

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Little is known relative to the shore-bug fauna of the family Leptopodidæ of the Philippine Archipelago. The first leptopodid was netted by Dr. R. L. Usinger on the Island of Luzon in 1936 and then later he described it in 1942 as *Erianotus buenoi.* The present paper characterizes a second Philippine species from the Island of Mindoro.

It is very interesting to note that the two species of leptopodids are typical member of the genus *Valleriola* Distant and that each differs from all their congeners in having the fourth antennal segment distinctly longer than the preceding. In addition to its larger size and color markings, *V. mindorana* sp. nov. can be separated from *V. buenoi* (Usinger) by its longer fourth antennal segment, which is longer than the second and third conjoined. In structural measurement employed, the description, 80 units are equal to one millimeter.

VALLERIOLA MINDORANA sp. nov.

Elongate-ovate, moderately wide, blackish fuscous with prominent ochraceous markings as described with structures; pronotum and hemelytra with some bluish bloom. Length, 5.25 mm; width, 1.35 mm.

Head blackish, shining, with base and some marking in front brownish flavous, deeply widely convex between eyes, beneath with three long whitish spines on each side, width across eyes, 1.35 mm; eyes very large, dark, slightly convergent anteriorly, each placed on outer end of thick and slightly upturned stalk; ocelli placed on top of a small elevation, with their inner margins nearly in contact. Rostrum stout, extending between fore coxæ; segment I more testaceous and longer than other segments, 0.50 mm long, armed beneath with two pairs (one pair near base and other near middle) of whitish, divergent spines directed ventrolaterally (pair on each side). Antennæ very long, slender, longer than body, 5.82 mm long; segment I short, thick, testaceous; II rather slender, straight, blackish fuscous, nude; III and IV very long, very slender, filiform, blackish, apical half of III and IV clothes with short, pale pubescence;

IV extremely long, longer than II and III taken together, measurements: I, 30; II, 74; III, 142; IV, 220.

Pronotum wider across humeral angles than median longitudinal length (85:112), strongly narrowed anteriorly, with a row of rather large pits in the bottom of the transverse impression separating lobes; collar considerably constricted, transversely furrowed, with an encircling row of pits in the bottom of the furrow; anterior lobe about half as wide as hind lobe, rather strongly convex, impunctate, longitudinally impressed on median line so as to divide the front lobe into two equal parts; hind lobe slightly longer than fore lobe and collar conjoined, closely punctate, convex posterior part more raised, with fewer upright pale hairs than front lobe, with hind margin and three rather large spots between humeri ochraceous. Scutellum impunctate, wider at base than median length, with a median basal impression. Body beneath blackish fuscous.

Hemelytra considerably longer than abdomen, tapering posteriorly behind the basal two-fifths; embolium narrow, whitish; clavus with inner margin behind scutellum and a long median stripe (extending almost its entire length) ochraceous; membrane dark fuscous with an ochraceous spot in outer cell; corium with a spot near outer margin of long inner cell, a small spot in small apical cell and a long stripe in long outer cell ochraceous. Legs long, slender, testaceous with a tinge of brownish, without stripes or definite brown or blackish markings; middle and hind legs very long and slender; fore femora moderately stout, armed on underside with two rows (plus some adventitious small spines) of rather closely set, small, slender, sharp spines, also with three or four much longer, straight, sharp, pale spines near both front and hind margins; fore tibiæ straight, armed with a median longitudinal row of small, sharp, brownish spines which are all uniformly tilted outward.

Holotype (male), Subaan, Mindoro, Philippines in my collection.

Easily distinguished from *V. buenoi* (Usinger) by the characters listed in the key herein for the separation of the Philippine leptopodids.

VALLERIOLA BUENOI (Usinger).

Erianotus buenoi USINGER, Brookl. Ent. Soc. Bull. 37 (1942) 103. (Types from Montalban, Rizal Province of Luzon, Philippines).

Valleriola buenoi DRAKE ET HOTTES, JOUR. Kan. Ent. Soc. 24 (1951) 21. (Transferred *buenoi* from *Erianotus* to *Valleriola*; generic characters amplified).

Valleriola buenoi DRAKE ET HOBERLANDT, Acta Ent. Mus. Nat. Pragae 26 (1951) 5. (Checklist of species of the world).

Valleriola buenoi DRAKE ET VIADO, Philip. Jour. Sci. 80 (1952) 339 (Recorded male from Laguna Province, Luzon).

Valleriola buenoi DRAKE and MAA, Quart, Jour. Taiwan Mus. (3–4) 7 (1954) 263. [Recorded *buenoi* from the Philippines (Luzon et Mindoro), So. China (Hainan), India et Ceylon].

This was the first leptopodid characterized from the Philippines. Since then, it has been netted in Luzon and Mindoro and also in India, Ceylon, and Hainan Island (So. China). Except for the new species described herein, *V. buenoi* may be distinguished at once from all other described members of the genus by having the fourth antennal segment longer than the third (154:130). The fourth antennal segment is shorter than two and three conjoined (154:212). The two leptopodids from the Philippines may be distinguished from each other as follows:

Key to the species of Valleriola

Body 5.40 mm long; antennal segment IV longer than the length of II and taken together; pronotum with hind margin and three fairly large spots (median and one on each side of it) on posterior lobe, inner margin and a long median stripe in clavus, a long stripe in large outer cell and a small spot in apical cell of corium, and a spot in outer cell of membrane ochraceous. ..... *V. mindorana* sp. nov.

Smaller, body 4.80 mm long; antennal segment IV shorter than II and III conjoined; pronotum with posterior margin only, clavus with short median stripe and small apical spot, corium with a spot on median vein and a small rounded spot in small apical cell, and outer cell of membrane with small rounded spot ochraceous ..... *V. buenoi* (Usinger)

FOUR NEW SPECIES OF GALL-MAKING LACEBUGS (HEMIPTERA: TINGIDÆ)

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TWO TEXT FIGURES

Insofar as known, all members of the tingid genera *Paracopium* Distant (1902), *Copium* Thunberg (1822), and *Onymochila* Drake (1948) are gall-making insects. *Paracopium* is the largest of the three genera, and more than 30 species have been described in the genus from Africa, Australia, Asia, Philippines, and other islands of the South Pacific and Indian oceans. *Copium* is a much smaller group and inhabits southern Europe and Asia (Japan, China, and Formosa). Both *Copium* and *Paracopium* develop on the inside of galls formed on the flowering parts of plants. *Onymochila* is represented by a single species from Pretoria, Africa; it produces leaf-curl galls. These three genera include all of the tingids known to produce galls, and the species are confined entirely to the Eastern Hemisphere. In the structural measurements used in the descriptions, 80 units equal one millimeter. The types are in my personal collection.

PARACOPIUM CONGRUUM sp. nov.

Small, grayish testaceous or brownish testaceous with some scattered veinlets dark fuscous. Head dark fuscous, armed with five, appressed, testaceous spines, the hind pair reaching to middle of eyes; eyes large, black; bucculæ brownish testaceous, closed in front. Labium extending slightly beyond middle of mesosternum, brownish testaceous; laminæ whitish, uniseriate. Antennæ rather, stout, not reaching to apex of triangular projection of pronotum; segment III rather stout, slowly enlarged apically; IV scarcely thicker than apex of III; measurements: I, 20; II, 12, III, 87; IV, 52. Orificé with a narrow upright channel. Hypocostal laminæ uniseriate. Legs blackish fuscous with tibiæ brownish or brownish testaceous. Body beneath dark fuscous with venter slightly reddish brown.

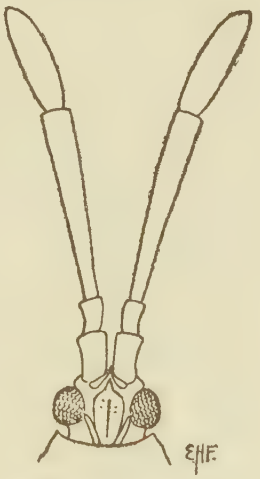

Fig. 1. *Paracopium congruum* sp. nov.

Pronotum moderately convex across humeri, very coarsely pitted, tricarinate; carinæ almost equally elevated, uniseriate, with areolæ rather small, the lateral pair slightly divergent anteriorly; paranota moderately wide, composed of a single row of moderately large, quadrate, hyaline areolæ; collar slowly elevated anterior, with three rows of cells. Costal area uniseriate, the areolæ clear and practically the same size as in paranota; subcostal area triseriate in widest part, areolæ a little smaller than in costal area; discoidal area three-fifths as long as elytra, widest behind middle (opposite apex of pronotal process), there six areolæ deep; sutural area with cells mostly slightly larger than in discoidal area.

Length, 4.00 mm; width, 1.25 mm.

Holotype (male), Victoria Falls, Rhodesia, July 12, 1942; *allotype* (female), and *paratype*, Belgium Congo (Musosa), November 1939, H. J. Bredo.

Separated from *P. fenestrellum* Bergroth by its slightly broader body and especially by its much thicker third and fourth antennal segments.

PARACOPIUM AFRICUM sp. nov.

Moderately large, broad, dark or blackish fuscous with a few scattered black marks, without vestiture. Head blackish, armed with five brownish spines, the hind pair appressed, scarcely surpassing middle of eyes, eyes large, black; bucculæ broad, areolate, closed in front, dark brown. Antennæ moderately stout, not extending beyond apex of hind pronotal process, black, densely clothed with short, subappressed, stiff hairs; segment III rather stout, gradually enlarged apically; IV scarcely thicker than III; measurements: I, 22; II, 16; III, 115; IV, 60. Labium reddish fuscous, extending slightly beyond mesosternum; laminæ pale widely separated, divergent posteriorly. Hypocostal laminæ uniseriate. Orifice with an upright channel. Thorax beneath blackish, the venter reddish brown. Legs blackish fuscous with tibiæ somewhat brownish.

Pronotum wide, broadly and rather strongly convex across humeri, very coarsely punctate (almost areolate), tricarinate; median carina thick, raised, areolate, the areolæ smaller on disc; lateral carinæ not quite as high as median, terminating anterior at calli, slightly divergent and feebly concave within in front of center of disc; calli deeply impressed, impuncate; collar considerably elevated, triseriate (two rows of cells up on top and behind one on oblique hind surface of elevation); pos-

terior triangular process very large, areolate, the areolæ not much larger than pits on pronotum proper; paranota moderately wide, widest opposite calli, testaceous with dark and thick cross-veins, uniseriate, the areolæ moderately large. Elytra broad; costal area rather wide, uniseriate brownish testaceous with cells hyaline, composed of ten to twelve fairly large quadrate cells which are separated from one another by two or four small cells, with thick and brown cross-veins, outer vein bordering larger cells testaceous; subcostal area quite wide, composed of four rows of areolæ; discoidal area large, two-thirds as long as elytra, acutely angulate at both ends, widest behind middle (opposite apex of pronotal process), there seven areolæ deep, the areolæ of discoidal and sutural areas about equal in size and largely slightly smaller than in sutural area.

Length, 5.25 mm; width 2.10 mm.

Holotype (male), Natal, So. Africa, July, 1955, A. L. Capener.

Separated from its South African congeners by broader form, costal area and pronotal carinæ.

PARACOPIUM DAUPHINICUM sp. nov.

Moderately large, blackish fuscous with sutural area largely brownish. Head blackish, with five brownish spines; anterior spines bent downward, with apices meeting on midline; posterior pair very long; slender nearly reaching to anterior margin of eyes. Labium brownish testaceous with tip blackish, extending slightly beyond middle of mesosternum; laminæ whitish, uniseriate. Antennæ black, moderately incrassate, not attaining apex of pronotal process, densely clothed with short, thick and flattened hairs; segment III moderately enlarged apically; IV very long, not much shorter, than and a little thicker than apical end of III; measurements: I, 18; II, 12; III, 70; IV, 62. Orifice with a narrow, upright channel. Body beneath dark reddish fuscous with venter paler. Legs blackish fuscous with tibiæ brownish fuscous.

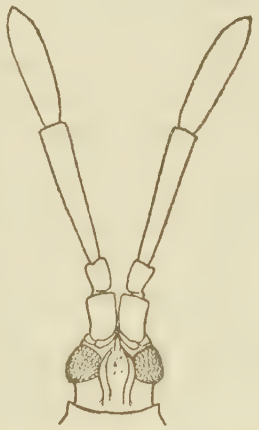

FIG. 2. *Paracopium dauphinicum* sp. nov.

Pronotum rather strongly convex, coarsely and almost areolately punctate tricarinate; carinæ deep black, uniseriate, with tiny and not always distinct areolæ, the lateral pair divergent in

front; collar raised, brownish at middle, with three encircling rows of areolæ; paranota rather narrow, uniseriate, with the five or six larger clear cells (exterior margin testaceous) separated from one another by two or three small cells with black-fuscous veinlets. Costal area moderately wide, composed of one row of irregularly spaced small and fairly large areolæ, larger areolæ with marginal vein testaceous, smaller areolæ surrounding by blackish veinlets, near the middle with a series of six to eight small cells, all areolæ hyaline; subcostal area mostly triseriate, quadriseriate opposite apex of discoidal area, the areolæ almost same size as in discoidal; discoidal area three-fifths as long as elytra, widest behind middle, there six or seven areolæ deep; sutural area with areolæ larger than in discoidal area.

Length, 4.20 mm; width, 1.54 mm.

Holotype (female), Fort Dauphin, Madagascar, 1899, taken by Sikara.

Distinguished at once from *P. fenestellatum* Bergroth and *P. parvum* Drake by the third and fourth antennal segments as described above. *Parvum* is a very small species with differently shaped body, and is the smallest member of the genus.

PARACOPIUM CALEDONICUM sp. nov.

Small, brownish fuscous with scattered veinlets slightly fuscous; paranota and costal area testaceous with transverse veins brownish, areolæ hyaline. Body beneath brown, the legs testaceous. Head blackish fuscous, armed with five brownish spines; three frontal spines short, appressed; posterior pair long, slender, appressed, extending anteriorly beyond middle of eyes; eyes large, reddish brown. Labium brownish testaceous with blackish apex, almost reaching to base of mesosternum; laminæ testaceous, uniseriate, widely separated, with a broadly V-shaped opening behind. Antennæ moderately long, moderately stout, not reaching to apex of hind pronotal process, densely clothed with extremely short, flattened, hairs; segment III rather slender, slowly enlarged towards apex; IV slightly thicker than appex of III, a little bent; measurements: I, 15; II, 12; III, 75; IV, 46. Orificial canal narrow, upright.

Pronotum moderately convex, very coarsely punctate, tricarinate, each carina uniseriate; median carina slightly more elevated than lateral pair, extending entire length of pronotum; lateral carinæ terminating anterior at calli, slightly divergent and feebly concave within in front of disc; collar distinct, triseriate;

paranota rather narrow, nearly upright, composed of one row of rectangular areolæ. Elytra feebly constricted on sides opposite apex of discoidal area; costal area composed of one row of moderately large, clear, rectangular areolæ, with exterior vein testaceous and cross-veins thick and brownish; subcostal area wider than costal area, biseriate; discoidal area five-ninths as long as elytra, five areolæ deep in widest part, areolæ of subcostal and discoidal areas equal in size; sutural area with a little larger and slightly clouded areolæ.

Length, 3.60 mm; width, 1.20 mm.

Holotype (male), *allotype* (female) and one *paratype,* New Caledonia, September 22, 1944, Wilfred Crabb.

Allied to *P. lewisi* (Distant) but easily separated from it by the shorter antennæ (*lewisi*: III, 100; IV, 60 and *caledonicum:* III, 75; IV, 46.)

COBRA-ANTI-VENOM SERUM PRODUCTION AT THE ALABANG SERUM AND VACCINE LABORATORIES *

By Walfrido de Leon and Enrique Salafranca
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Cobra-anti-venom serum production at the Alabang Serum and Vaccine Laboratories is still limited. It is an extension of our work on the use of cobra venom in cancer cases.[1] We strive to have, at all times, a supply of potent and properly tested sera for emergency use.

Production of this serum in the Philippines is beset with many difficulties. One handicap is the inadequate supply of suitable horses. In the beginning, lack of cobras accounted for the very slow progress of our work. How to keep cobras healthy in captivity was a big problem. In this report we shall give you an idea of the materials we work with, our immunization procedures, the methods we have employed in determining the toxicity of the venom for the various laboratory animals, and the potency of the serum, the problems we have encountered, as well as other pertinent observations which we have made in the course of this work.

MATERIALS

Cobra-venom.—Our supply of cobras (*Naja Naja Philippinensis*) has, thus far, come mainly from the Bicol regions and the provinces of Rizal, Laguna, and Nueva Ecija. The cobras are obtained by purchase from people who catch them and bring them to the laboratory. At time of acute shortages, one of our cobra tenders is sent out to hunt for them. The Bicol provinces have always yielded a good number. The weeks preceding, during and after the rice planting and harvesting seasons seem to be the best time for collecting cobras. Apparently, the abundance of small animal life upon which they feed, like

* Read before the 48th Annual Meeting of the Philippine Medical Association held in Baguio, April 27 to 30, 1955.

[1] Leon, Walfrido de. Cobra venom: its possibilities in the Philippine medicine. Jour. Philip. Med. Assoc. 22 (1946) 1–6.

birds, and their eggs, chicks, field mice, and frogs draw the cobras out. About this time, more instances of cobra bites are reported.

The specimens brought to the laboratory range from 2′10″ to 4′6″ in length. The general coloring varies from a pale light green or straw color, through shades of yellowish green to dark olive green, depending on the color or abundance of vegetation of their habitat.

At the laboratory serpentarium they are milked once a week for venom. The cobra tender makes a fast grab for the tail end and brings this up in one motion with his right hand. He grasps this end firmly but gently and holds it off at about arm length with the head barely resting on the ground. At an opportune moment when the animal is apparently calm with its head resting on the ground and directed away from the tender, the latter, with a decisive move, pins the head to the ground with the fingers of his left hand and with his thumb and forefinger he grasps the head firmly just behind the angles of the jaw.

A light tap on the dorsum of the head usually induces the animal to open its jaws. The lip of a glass tube, 610 × 30 mm, is inserted between the jaws (with the fangs inside the tube) and the cobra is made to bite the wall of the tube or its upper jaws pressed down firmly. The venom from the poison gland is released in the act and flows through its secretory duct to the base of the fangs and through the bore of the latter the poison is made to trickle to the side of the test tube.

The venom is syrupy in consistency and varies from a crystal clear, colorless fluid to a pale yellow or light amber color with varying degree of turbidity and admixture of suspended particles of extraneous matter. It is odorless. This is kept in the tube and dried in a dessicator under vacuum over calcium chloride. The dessicator is kept at about 5°C and in the dark.

The dried venom is crystallized and when dried, as described above, it is pale yellow to light amber in color. The amount of dried venom obtained from freshly caught specimens which range from 2′10″ to 4′ in length vary from 17 to 72 mg.

For immunization as well as for serum titrations we always employ a pool of dried venom from several cobras for preparing our stock solution.

The dried venom is weighed very carefully in an analytical balance. A one per cent solution is prepared using sterile phy-

siological salt solution with 0.5 per cent phenol. This is the stock-solution from which doses for immunization are prepared.

In later trials, this solution was sterilized by filtration through Seitz or Berkefeld filter before preparing the doses for immunization.

In more recent trials, the cobra venom solution was converted to anavenene by treating it with formalin on a 0.4 per cent final concentration. This solution so treated was incubated at 37°C. It required a period of about 35 days to detoxify the venom sufficiently so that the equivalent of 10 mouse CLD could be given to white mice intravenously without killing them.

To determine the CLD in the various laboratory animals used for serum potency titrations, the unfiltered 1 per cent stock solution was used as the initial dilution. In later trials, the filtered 1 per cent venom solution was used. "Certain lethal dose" determinations were made in guinea pigs, white rats, and in white mice. The results of the several trials are given in Table 1.

TABLE 1.—*CLD determination of cobra venom in guinea pigs, white rats, and white mice.*

Animal	Weight	Route of injection	Certain lethal dose
	gm		*mg*
Guinea pig	330–360	Subcutaneous	0.015–0.04
White rats	110–120	Subcutaneous	0.015–0.02
White mice	20–±0.5	Intravenous	0.004–0.009

We have found white mice very convenient to work with. The technique of injection (intravenous) is a little more difficult but with a little practice one can acquire sufficient dexterity.

The toxic symptoms observed in the laboratory animals used for venom titrations indicate the presence of neurotoxins, hemolysins, and hemorrhagins among the constituents of the venom of Philippine cobras. The symptoms and lesions observed in horses which came down with cobra venom toxemia following toxin injections, the reactions observed in our cobra tenders following accidental bites or following immunization, and those observed among cobra bite victims taken to the laboratory for emergency treatment indicate, in addition, the presence of cytolysins, proteolysins, and hemocoagulins (anti-coagulant principle).

TABLE 2.—*Reactions, symptoms, and lesions observed in men and animals with venom toxemia.*

Subject	Manner of venom introduction	Observations
Cobra tender	Accidental bites	Pain and swelling at site of bite. An accidental bite which punctured a blood vessel in the hand resulted in marked weakness, respiratory distress, difficulty of speech and collapse. Recovered in about 3 hours. Tissues around the site became necrotic and sloughed.
	Injection of immunizing dose subcutaneously	Localized, pain, redness, swelling, headache, dizziness, temporary clouding of vision, weakness.
Horses	Injection of immunizing dose subcutaneously	Extreme debility, incoordination, edema of lips, checks, chest, and pendant portions of the body; swollen and petichiated tongue with paralysis. Hemorrhages and congestion of internal organs, edema of intestinal wall, necrosis of tissues with sloughing, hemorrhage, from eyes, and nostrils, blood dark, hemolized frothy, and noncoagulated. Death.
Guinea pigs	Injection of venom, subcutaneously	Rapid respiration; marked relaxation of musculature, the abdomen appearing markedly compressed laterally and touching the floor, salivation, weakness, collapse, and death.
White rats	Injection of venom, subcutaneously	Very marked weakness, rapid respiration, lachrimation, salivation, hemorrhage from eyes and nostrils, incoordination, congestion, and hemorrhage of internal organs.
White mice	Injection of venom, intravenously	Weakness, incoordination, relaxation of muscles, collapse, rapid respiration, hemorrhage from eyes, nose, and mouth. Congestion and hemorrhage of lungs, spleen, and kidney.

The cobras are fed live mice and frogs. In addition, they are artificially fed once a week through a small funnel with fresh eggs beaten previously to a uniform consistency. Small chunks of fresh meat, when available, are also fed to them. The feeding has to be done after venom extraction because handling them immediately after, and for sometimes after feeding, usually results in the regurgitation of the injected feed. Also during handling some spit or eject venom as they struggle and raise their heads and spread their hoods in preparation to strike, resulting in the loss of venom. It is therefore preferable to feed them after milking.

Under captivity, our cobras have been observed to live for about seven months on the average. Some last about a year and some die sooner. During molting, which has been observed to occur at about monthly intervals in individual snakes, very little or no venom may be extracted.

Antivenin production.—For the production of the antivenene, healthy horses 4 to 5 years old are selected. Limited observations indicate that young horses respond better to immunization procedures.

The other essentials for this work include an analytical balance, suitable sterilizing filters, plus the usual laboratory materials including chemically pure cresol, neutral formalin and C. P. sodium chloride as well as the usual facilities for routine bacteriological work. Suitable animals for testing the venom, anavenene and antivenene include rabbits, guinea pigs, and white mice.

A good cobra tender is a very valuable asset in the collection of venom. Immunity to the venom is desirable, so we only employ cobra tenders artificially immunized in the laboratory. Dexterous handling of these reptiles and possession of steady nerves are important criteria in the selection and training of a good cobra technician.

METHOD OF IMMUNIZATION

The general scheme followed in the immunization of horses is to gradually build up their antivenene titer by the regular subcutaneous injections of increasing doses of the antigen. Since the beginning of this work and until recently, the antigen employed for immunization was prepared by simply diluting the dried venom with sterile physiological salt solution with addition of 0.5 per cent phenol as already mentioned elsewhere.

In the absence of data on the relation of toxicity of the venom to weight and individual sensitiveness of the horses, we had to start with a high dilution of the venom to avoid producing toxic symptoms.

The injections are given at weekly intervals. A given dose is repeated two or more times to allow the development of sufficient antibodies to enable the horse to stand the next larger dose. Subsequent doses are increased very gradually. The procedure, as one can see from the protocol of one of the horses which is reproduced in part below, is time consuming. This becomes more so when we encounter individual horses which respond very poorly to the antigen. A screening procedure would be of great help; but with our very limited supply of

TABLE 3.—*Protocol of immunization schedule of horse No. 833*

Date	Antigen		Administration	Remark
	Titer	Dose		
		cc.		
6-15-53	1:10,000	1	Subcutaneous	Plain venom dilution; not filtered.
6-18-53	1: 5,000	1	do	
6-25-53	1: 5,000	1	do	
7- 2-53	1: 5,000	1	do	
7- 6-53	1: 5,000	1	do	
7-10-53	1: 5,000	1	do	
7-18-53	1: 5,000	1	do	
7-19-53	1: 5,000	1	do	
7-25-53	1: 5,000	1	do	
7-28-53	1: 5,000	1	do	
7-31-53	1: 5,000	1	do	
8- 4-53	1: 5,000	1	do	
8- 7-53	1: 3,000	1	do	
8-14-53	1: 3,000	1	do	
8-21-53	1: 3,000	1	do	
8-28-53	1: 3,000	1	do	
9- 4-53	1: 3,000	1	do	
9-11-53	1: 3,000	1	do	
9-18-53	1: 3,000	1	do	
9-25-53	1: 3,000	1	do	
10- 2-53	1: 3,000	1	do	
10- 9-53	1: 3,000	1	do	
10-16-53	1: 3,000	1	do	
10-23-53	1: 2,000	1	do	
10-30-53	1: 2,000	1	do	
11- 6-53	1: 2,000	1	do	
11-11-53	1: 2,000	1	do	
11-14-53	1: 2,000	1	do	
11-17-53	1: 1,000	9	do	
11-20-53	1: 1,100	1	do	
11-23-53	1: 1,000	1	do	
11-27-53	1: 900	1	do	
12- 1-53	1: 800	1	do	
12- 4-53	1: 800	1.25	do	
12- 7-53	1: 700	1	do	
12-10-53	1: 600	1	do	
12-14-53	1: 500	1	do	
12-17-53	1: 400	1	do	
12-21-53	1: 300	1	do	
12-24-53	1: 200	1	do	
12-28-53	1: 100	1	do	
1- 4-54	Bled 3 liters		Neutralization titer 2.5 mg.	

suitable horses, we have to use the best available. To maintain a supply of the potent serum we have been forced to use some of the very young horses bred in the laboratory with fatal results in some. It will be observed from the protocol of horse No. 833 that it actually required seven months to develop a neutralizing titer of 2.5 mg with this method.

About the later half of 1954 we started experiments with detoxified cobra venom (anavenene). This was prepared as described previously. Our object was to find out whether anavene prepared in this manner retained its antigenic qualities.

In November, 1954, we started two horses (Nos. 17 and 18) on anavenene immunization. The initial dose contained the equivalent of 1 mg (0.1 cc of 1:100). The injections were given at weekly intervals except when there was a shortage of venom. On March 2, 1955, a preliminary titration of the serum of both horses gave a neutralizing titer of 0.04 mg or a protection against 10 mouse CLD per cc of serum. At the time of preliminary bleeding, No. 18 had received a total amount equivalent of 76 mg of dried venom and No. 17, 94 mg (Table 4).

TABLE 4.—*Protocol of immunization of horse No. 17 (anavenene).*

Date	Antigen		Administration	Remarks
	Titer	Dose		
		cc		*mg*
11- 4-54	1:100	0.1	Subcutaneous	Anavenene = 1
11-11-54	1:100	0.2	do	do = 2
11-19-54	1:100	0.3	do	do = 3
12- 1-54	1:100	0.5	do	do = 5
12- 8-54	1:100	0.5	do	do = 5
12-16-54	1:100	0.7	do	do = 7
12-28-54	1:100	0.7	do	do = 7
1-13-55	1:100	1.0	do	do =10
1-20-55	1:100	1.0	do	do =10
1-29-55	1:100	1.5	do	do =15
2- 8-55	1:100	1.4	do	do =14
3- 2-55	1:100	1.5	do	do =15

On March 5, 1955, we started two other horses (Nos. 23 and 24) of ages comparable to those of horses Nos. 17 and 18 on immunization schedules using plain filtered venom. The idea was to compare the neutralizing titers developed in these horses with those on immunization schedules using anavenene at comparative stages of the immunization, i.e., at stages when the horses in both groups had received approximately the same amount of the equivalent in dried venom. Incidentally, the

dosages of the fitered venom administered to the horses of this group were measured in terms of mouse CLD. We believed that the increase in dosages could be more accurately gauged by following this procedure in view of the variations in potency of the dried venom detected in the CLD titrations.

The use of cobra anavenene to stimulate the production of cobra-antivenene antibodies in horses appear promising. We hope to be able to gather more data to substantiate this possibility. This method offers a safer and more efficient means of immunizing individuals in whom accidental bites by cobras is an occupational hazard.

DETERMINATION OF THE NEUTRALIZNG POWER OF THE COBRA-ANTI-VENOM

Several methods are available for arriving at the neutralizing titer of a given lot of cobra-anti-venom serum. In our laboratory we employ one or both of two methods.

The first, more time consuming and requiring more test animals and a larger serum sample, involves titration of the serum at various levels. Each level of serum is titrated against varying amounts of the venom. These amounts are determined by (*1*) the particular level of the serum being tested, (*2*) the CLD titre of the venom being used, and (*3*) previous neutralization titer of the serum of the horse under test. From the results obtained the titer of the serum may be determined by the following formulas:(2)

$$\text{Quantity by venom neutralized by 1 ml of antivenene} = \frac{\text{amount of venom} - 1\ \text{CLD}}{\text{amount of serum} - \text{dose } S_1}$$

S_1 representing the dose of serum which protects the mouse against 1 CLD of venom

Where the serum has been titrated of various levels this formula becomes:

$$\text{Neutralizing titer of the serum between two levels} = \frac{\text{Dose of venom at higher level} - \text{Dose of serum at lower level}}{\text{Dose of serum at higher level} \quad \text{Dose of serum at lower level}}$$

The second method is to determine the approximate number of CLD which 1 cc of the serum is capable of neutralizing. Varying amounts of serum is titrated against 1 CLD of the venom or any definite number of CLD. The least amount of serum which neutralizes 1 CLD is determined. The number of times this amount is contained in 1 cc gives the approximate number of CLD which 1 cc of the serum will neutralize. The

amount of venom representing one CLD multiplied by the number of CLD neutralized by 1 ml of the serum gives the neutralization titer of the serum tested.

$$\text{Number of CLD neutralized by 1 cc serum} = \frac{1}{\text{least amount of serum neutralizing 1 CLD}}$$

$$\text{Number of CLD neutralized by 1 cc serum x 1 CLD} = \text{neutralization titer of serum}$$

The first method makes a correction for the venom which may be neutralized by native antibodies in the test animal. With either method, we allow a neutralization period of 30 to 45 minutes at room temperature before the serum-venom mixtures are injected into test animals. Any of the small laboratory animals may be used. As mentioned previously we have found the white mice very convenient to handle and economical. A period of 48 hours is allowed for observation before reading the results.

The following serum potency test protocols illustrate the two methods discussed.

TABLE 5.—*Method No. 1.*

A. Date done: 2–25–55 Sample 1

Weight of animals (White mice)	Identification marks	Serum dose	Venom dose	Observations	
				24 hours	48 hours
		cc	*gm*		
20 gms each	Red head	0.05	0.000014	D.O.A. 2–26–55	
do	Red back	0.05	0.00001	D.O.A. 2–26–55	
do	Red hind	0.05	0.000007	O. K.	O. K.

B. Date done: 2–25–55 Sample 1

Weight of animals (White mice)	Identification marks	Serum dose	Venom dose	Observations	
				24 hours	48 hours
		cc	*gm*		
20 gms. each	Blue head	0.15	0.000028	D.O.A. 2–26–55	
do	Blue back	0.15	0.000021	O. K.	O. K.
do	Blue hind	0.15	0.000014	O. K.	O. K.
do	Red tail	-------	0.000007	D.O.A. 2–26–55	

D.O.A. = Dead on arrival

Using the formula given above we have:

$$\text{Quantity of venom neutralized} = \frac{0.000021 - 0.000007}{0.15 - 0.05} = \frac{0.000014}{0.1}$$

0.00014 gm or 0.4 mg

$\therefore$ Neutralization titer = 0.14 mg

TABLE 6.—*Method No. 2.*

Date done: 3–8–55 Sample 2

Weight of animals White mice	Identification marks	Serum dose	Venom dose	Observations	
				24 hours	48 hours
		cc	*gm*		
20 gms each	Violet head	0.2	0.000004	O. K.	O. K.
do	Violet neck	0.1	0.000004	O. K.	O. K.
do	Violet back	0.05	0.000004	Died about 3 p. m. 3–8–55	
do	Violet hind		0.000004	Died about 2 p. m. 3–8–55	

$$\text{Number CLD neutralized by 1 cc serum} = \frac{1}{0.1} = 10$$

10×0.000004 gm or 0.04 mg neutralization titer

SUMMARY

For the production of cobra-anti-venom serum, young, healthy horses are stimulated to produce the specific antibody by subcutaneous injection of gradually increasing doses of the cobra venom.

Very limited trials with detoxified cobra venom (anavenene) for immunization of the horses show indications of promising result.

Two methods for determining the potency of the serum are employed. One method involves the titration of the serum at various levels, each level being titrated against varying amounts of the venom. The other method involves a titration of varying amounts of the serum against 1 CLD or any definite number of CLD.

CONCLUSION

There are many factors in local cobra antivenene production which require further observations to improve methods for more economical and effective production. The following are some of them:

(1) To develop a workable and effective screening method to eliminate horses which are likely to respond poorly to the immunization.

(2) To determine the toxicity rate of the venom according to the weight of the horse. This data will greatly eliminate fatalities especially at the onset of immunization and possibly accelerate the process.

(3) To make a comparative study of the specific antibody production following the use of various forms of the antigen to determine the one which induces the best response, and

(4) To make a comparative study of the various routes of administration of antigen to determine the most suitable.

A REVIEW OF THE DEVELOPMENTS AND PRESENT STATUS OF THE DEPARTMENT OF HEALTH PROGRAMS ON VACCINE AND SERUM PRODUCTION, SCHISTOSOMIASIS, MALARIA, AND LEPROSY *

By Walfrido de Leon
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Sera and vaccine production in the Philippines and the program of vaccination in the systematic fight to control and eradicate the epidemics of infectious diseases that had ravaged the country for centuries were right at the start intricately linked with the establishment of the Bureau of Science.

The first impact in the Philippines of European discoveries in the new science of bacteriology and immunology occurred when an expedition, dispatched in 1805 by King Charles IV from Mexico, of Francisco Xavier y Balmis carried a cargo of healthy orphan children who serially received smallpox vaccine through out the duration of their long voyage across the Pacific Ocean. On arrival in the Philippines, the vaccine was transferred from arm to arm of healthy Filipino children. It was not until 1894, however, when production of anti-smallpox vaccine was inaugurated in the Instituto Central Microbiologico de Vacunacion under Dr. Salvador Ramos, its director.

A progressive and aggressive program of laboratory work was soon established in the country upon the arrival of American pioneers of public health when they established the Bureau of Government Laboratories in 1901 with Dr. Paul C. Freer as superintendent and Dr. Richard P. Strong as director of the Biological Laboratory of the same bureau. In 1906, the establishment became the Bureau of Science which, after its total destruction in World War II, was renamed Institute of Science and Technology in 1947.

The brilliant laboratory works of Strong, Musgrave, Clegg, Reudiger, Barber, Crowell, Schöbl, others gained a world-wide reputation for this institution and contributed much to further progress and advance in public health work in the Philippines.

* Paper read at the symposium on medical sciences and health of the community held in connection with National Science Week at the Science Hall, Philippine General Hospital, November 22, 1955.

It was through the efforts of these workers that compulsory anti-smallpox vaccination in 1901; vaccination against cholera in 1905; prophylactic treatment against rabies in 1910; and anti-typhoid vaccination in 1912, were made possible. These activities led to the remarkably successful control of the most virulent and devastating epidemic diseases that for centuries before had continually visited the Philippines, decimating yearly and keeping her population low and stagnant.

With the establishment of the Bureau of Science, which conducted researches on local disease control and which set off the production of vaccines, the government, through the Bureau of Health, inaugurated the systematic large-scale vaccination of the population, resulting two decades later in the successful eradication of smallpox and cholera. Smallpox was totally exterminated by 1920; cholera, in 1925.

In order to maintain these epidemics under control, in 1920 the then Secretary of Agriculture, Dr. Galicano Apacible, transferred the Serum and Vaccine Laboratory, which was then occupying the rear quarters of the Bureau of Science building, to a more suitable and spacious location of nearly a hundred hectares in extent at Barrio Alabang, Municipality of Muntinlupa, Rizal Province. In its new and well situated location, the laboratory continued to grow and expand under the supervision of the late Dr. Otto Schöbl. Large-scale production of the vaccines and sera needed by the Philippine Health Service in its progressively expanding immunization work in the provinces was made possible.

Upon the establishment of the Philippine Commonwealth and as a result of the government reorganization in 1936, the Biological Products Laboratory at Alabang and all the medical laboratories rendering public health work in the Bureau of Science were transferred to the Department of Sanitary Bacteriology and Immunology of the School of Hygiene and Public Health, now Institute of Hygiene, University of the Philippines. Under the School of Hygiene, the Serum and Vaccine Laboratories made considerable progress. Its compound was totally deforested, roads were constructed around, criss-crossing the compound, old laboratory buildings were reconstructed, a new large concrete laboratory building was added, and residences for the staff and other employees were built.

Despite the Japanese occupation, from 1941 to 1945, the production of vaccines and sera went unhampered and unmolested

and the yearly massive vaccination program of the government was pushed through as usual unrestrictedly.

During these war years, Philippine health service suffered paralization. Quarantine regulations were ignored. Environmental sanitation measures were disregarded. Garbage disposal was neglected. There was food shortage. Flies, mosquitoes, and other vermins multiplied rapidly. Even the City of Manila, usually kept sanitarily clean, appeared like any backward oriental city, its streets being unswept and littered with all sort of refuses, and human scavengers such as writhing beggars and undernourished children digging in garbage heaps to retrieve anything for food. In short, all the conditions necessary to spark epidemics were present.

The only health measure that could be carried out by public health officers more or less effectively and unmolested was the systematic massive immunization campaign which was intensified with more vigor than before the war, with the encouragement and support of the Japanese medical authorities.

Fortunately for the Filipinos, the effect of previous systematic yearly immunization undertaken since the start of the 20th century must have progressively bolstered their resistance to such an extent that, notwithstanding complete lack of sanitation, constant exposure to dirty and insufficient foods and unsafe water supply, and lack of preventive measures to ward off the danger of infection from neighboring countries as a result of the intermingling of foreign troops without regard to quarantine restriction, it was quite satisfying to note that, during the three years of Japanese occupation, no epidemics of cholera or smallpox and no significant increase in the incidence of other enteric diseases that usually accompanied previous wars were observed; this notwithstanding the actual presence of epidemics of cholera and smallpox in the nearby surrounding countries of Southeast Asia.

In November 1947, the Government reorganization undertaken shortly after the establishment of the Philippine Republic saw the Serum and Vaccine Laboratories with the Food and Drugs Laboratory transferred to the then newly organized Department of Health. Their transfer was aimed toward the organization of a well-balanced Department of Health in order to have at its immediate disposal the implements with which to combat such epidemics as should threaten the health of the country.

Thus the nucleus of the Division of Laboratories of the Department of Health was formed. This division was in 1950 raised to the rank of an office and renamed Public Health Research Laboratories. The office serves as the national public health laboratory of the Philippines and is directly under the Department of Health.

The establishment of the Public Health Research Laboratories is a definite step toward the implementation of the aim of the Government to make available to the people the facilities of an adequate laboratory service. The work of the laboratory complements the services of the Bureau of Hospitals, the Bureau of Health and the Bureau of Quarantine, and renders the organization of the Department of Health more complete and well-balanced and effective in carrying out more vigorously the Government's program of promoting the people's health.

This laboratory is supported by a revolving fund of ₱500,000. The United States Army helped the laboratory to get on its feet after the liberation of the Philippines by loaning to it some equipment and facilities to start production of vaccines which were immediately needed. In 1947 the United States Public Health Services Philippine Rehabilitation program chipped in with the necessary equipment, supplies and additional personnel. The laboratory received further aid from FOA–Philcusa agencies when it was given in 1952–55 the sum of ₱200,819.28 for necessary equipment.

In July 1950, the BCG laboratory was added to the physical plant. This new building was made possible by multi-lateral financial aids from several quarters and entities: namely, the fund for the construction of the building (₱200,000.00) donated by the Government (Philippine Charity Sweepstakes) ; the basic laboratory equipment of more than ₱60,000.00 donated by the United States Public Health Service, Philippine Health Rehabilitation Program; the more specific BCG equipment donated by the UNICEF; the technical assistant expert sent here from Norway to approve the operation contributed by the WHO; the training of the BCG technical staff facilitated by the Danish Red Cross; and the contribution of the Government for the initial and subsequent operation of the BCG Laboratory in the form of a continuing appropriation of ₱100,000.00 yearly.

In 1953, the UNICEF contributed additional equipment, laboratory apparatus, and supplies for the manufacture of Diph-

theria Toxoid which is now under current production. In 1954, the Plasma Dehydrating Laboratory building, authorized by Republic Act Nos. 662 and 774, was completed at the cost of ₱500,000.00 The laboratory, where blood plasma is at present being processed for drying, occupies the first floor of this building; the Manila Service Laboratories, the second floor.

The Serum and Vaccine Laboratories together with BCG Laboratory and the Plasma Dehydrating Laboratory constitute the production laboratories of the Public Health Research Laboratories.

The biologic products manufactured in these laboratories are all for prophylactic purposes and are intended to supply the needs of all the government entities engaged in the large-scale immunization of the Philippines. Sufficient amounts for exports to neighboring East Asian countries are also manufactured.

The laboratories put out the following principal products:

1. Cholera, dysentery, typhoid, and para A vaccines.
2. Pure cholera vaccine.
3. Anti-rabies vaccine.
4. Smallpox vaccine.
5. Prophylactic anti-tetanic serum.
6. Anti-dysenteric serum (now only used for desensitizing).
7. Cobra venom dilutions (for treatment of cancer pains).
8. Cobra anti-venin serum (for cobra bites).
9. BCG vaccine and tuberculin dilutions.
10. Diphtheria toxoid.
11. Tetanus toxoid (may be combined with CDT).
12. Dehydrated blood plasma and concentrated human cells.
13. Blood typing sera.
14. Bacterial antigens for Widal tests.
15. Bacterial antigens for Weil–Felix reaction.
16. Pertussis vaccine.

Although the bulk of its products is used locally for immunization purposes, from time to time at the request of the FOA or the UNICEF, some of its products are exported to the different neighboring countries such as Burma, Thailand, Formosa, Hong Kong,

and Borneo. At present it still supplies BCG vaccine and tuberculin dilutions to Hong Kong, Borneo, and Indonesia. The exportations to these countries contribute greatly to the prestige of the Philippines abroad and help to increase the dollar reserve of the Philippines.

In the control of communicable disease, the Public Health Research Laboratories participate actively with the Department of Health in its intensive researches on these diseases as they affect the rural population. Reference is made to snail fever (Schistosomiasis) and malaria which are now recognized not only as national public health but also as socio-economic problems. These chronic debilitating diseases affect mostly the farmers whose agricultural productivity is reduced once affected by the diseases.

On Schistosomiasis or snail fever, extensive surveys have been made especially during the last few years in the Southern Philippines, resulting in the definition of geographical distribution as well as the magnitude of this disease. It is now known that there are no less than 300,000 cases in twelve provinces in the Philippines, mostly in the Eastern Visayas, Mindanao, and Mindoro. The only province in Luzon so far affected is Sorsogon.

Because of the present meager knowledge of the various aspects of this complicated problem, it has not been possible to prepare a workable control program for its solution. Neither has a pattern for such a control program been tried successfully in other countries. The control of Schistosomiasis, because of its importance, is therefore one of the most fertile fields for research that should be undertaken.

In this connection, in 1952, a Schistosomiasis expert team of the World Health Organization came to the Philippines at its request to assist in evaluating the magnitude of the Schistosomiasis problem in the Philippines, to examine the actual work being done, and to make recommendations. One of the recommendations made was to establish, a pilot project where the most effective and practical methods of control might be tried and used, if successful, as a basis for the preparation of a control program on a national scale.

The method of controlling the disease previously followed from 1949 to 1952 was endless and unrewarding, because patients treated either suffered relapses or sooner or later were reinfected. The only sound approach to control work was to prevent transmission as completely as possible, or to protect the people from

infection. In view of this, the recommendation referred to was adopted by the Department of Health in the absence of another solution that the expert team could offer then.

After some deliberations, a field laboratory or project headquarters was put up in Palo, Leyte. The pilot project actually started operating by the middle of 1953 with the assistance of the PHILCUSA, the ICA (formerly FOA), the WHO, and the UNTA. Even while the field laboratory building was being constructed, a census of the human and animal population of Palo and Tanauan by the personnel of the Division of Schistosomiasis, using a standard method of stool examination, was undertaken to determine the incidence of the disease in both towns. Intensive snail surveys were made and the snail population in each colony was ascertained (by the "ring" and "tube" methods). Snail infection rate in the important colonies was also taken at the start and periodically thereafter.

With these baseline data, short-term and long-term researches were undertaken with the end in view of knowing more about the life cycle and biology of the parasite; the disease produced in man, its transmission, manifestations, epidemiology and the various environmental factors affecting the propagation, distribution and severity of the disease; the various animals serving as reservoir hosts; the habits and ecology of the snail vector; and the host-parasite relationship and host-environmental set-up in the pilot area.

Soon after the vital information needed was known, experiments on control were developed and tried on a small scale. The effects on snail population of clearing, drainage, filling, ponding, and scientific farming were studied. Results from these experiments were quite encouraging. It was found that snail density was markedly reduced. Biological control, using ducks as a snail predator, was also tried; but after a year, hardly any reduction of the snail population was noted.

At present, the most basic and obvious method of control by cutting transmission through proper sewage disposal is being tried in one barrio, and effects on snail infection rate in colonies "near" and "far" from houses are being investigated. An evaluation of the effectiveness of this measure can be expected upon completion of the experiment, the results of which, if successful, may lead to its final adoption.

Thus far, all the experiments tried in this pilot project indicate strongly that the solution to the Schistosomiasis problem

may yet be found eventually. Much will depend upon the people themselves, however. It is hoped, that before long, specific recommendations on the effective, economical, and adoptable methods of control may be submitted, upon which a national Schistosomiasis control program may be based, prepared and implemented.

With regard to the malaria program of the Department of Health the methods now being applied in control operations have been based on the scientific field investigations gathered during the last 27 years through the painstaking efforts first of Manalang and Ejercito and later of Ejercito and his staff, who continued the work with the same fervor and enthusiasm.

The malaria control methods in the past, such as the antilarval (Paris-green) and naturalistic methods of control previously tested effective, are now being tried on a nationwide scale. The present method of insecticidal control with the use of DDT has been previously tested in the so-called Mindoro Pilot Project before its nationwide use. The annual nationwide DDT residual sprayings of all houses in all malarious areas during the past two years have brought out a remarkable cutting down of malaria transmission, so that roughly, it has been observed that malaria has been reduced by 65 per cent (by infant parasite rate) in its prevalence. There is no question that DDT residual spraying of houses as a malaria control method is effective for a short-range malaria control program in rural areas by cutting down transmission at the shortest time possible. This method makes possible the building of roads through malarial-infested forests to be accomplished in a short time, or the establishment of new colonies in malarious areas.

At present, the so-called Dieldrin Project and the Toxic Harborage Project are being tried in the field. The former is the spraying of houses in a hyperendemic malaria area with Dieldrin which is considered more potent and toxic than DDT as an insecticide. The idea in this project is to find out whether or not it is possible to reduce the cost of operation by shifting from the use of DDT, to the use of Dieldrin, and whether or not the former is less effective than the latter. In the second project, the spraying of all harborages of the vector species is being tried along the banks of streams with DDT mixed with a sticker; thus, shifting the spraying of insecticide from houses to the natural harborages. The idea behind this project is to find out whether in the long run it is more economical and effective to use

the insecticide method by directing it to the natural abode of the vector species than to attending to houses where such vector species usually come only for blood meals.

These two experimental projects (Dieldrin and Toxic Harborage) have so far proven to be effective; but there is need for much longer observation and definite confirmation before their nationwide applications can be instituted.

Aside from these residual spraying control methods mentioned, there is being tried the mechanical method of malaria control requiring hydro-technical skill. This mainly consists of reclamation and drainage. Under Philippine conditions, such method as reclaiming seepages and streamlets by terracing and converting them into rice-paddies has been found effective for controlling mosquito population. This has been termed sanito-agronomic, because it involves sanitation and agriculture. In a bigger stream, dams are constructed to convert such a stream into series of ponds for fish culture, the fish helping in exterminating larvæ, the ponding driving the mosquitoes away. This method is briefly described as sanito-aquanomic, for it is a combination of sanitation and fish culture. In a still bigger stream, the automatic siphon devices are used, automatically flushing streams periodically, and thus, entirely eliminating the breeding of the vector species.

These methods of control are of permanent character and are useful in potentially or actually productive communities. Such permanent malaria control methods of dual purposes have been tried out successfully in the field.

As regards treatment of carriers and cases, synthetic drugs such as 4-amino-quinoline and 8-amino-quinoline derivatives have been found effective in parasitic control, so that by dispensary system of drug distribution such modern effective drugs have been made of good use.

Lastly, it may be mentioned that in this malaria control program, for the implementation of any project, trained technical personnel are needed. The training of these technical personnel is being done in the Institute of Malariology.

It may be gleaned from the foregoing that the malaria control program of the Department of Health has been so balanced as to bring fruitful results.

LEPROSY

Since leprosy bacillus has not yielded to successful cultivation, only the system of leprosy segregation adopted in the Philippines

since 1906, has been found as a suitable control. The method had been studied by countries with a leprosy problem for many years and Culion Leper Colony is known all over the world as a model leprosarium. However, due to the disruption of the family ties involved in this system, a wide-spread public opinion in the Philippines against the isolation of lepers in the Culion Leper Colony prevailed in the beginning. Doctors Jose Albert and Luis Guerrero furnished scientific observations which led to a gradual liberalization of the original strict segregation policy. Consequently in 1928, the first regional sanitarium was constructed in Cebu by Rodriguez, followed the next year by the establishment of similar regional leprosaria in Albay, Iloilo, Zamboanga, leading to the decentralization of the segregation system. At the same time, stationary skin clinics were established in connection with most of the regional leprosaria.

Due to lack of basic data regarding the disease, there was no direction at the beginning regarding scientific researches in the Philippines on leprosy until 1914, when a committee on leprosy was appointed. The first work of this Committee was to evaluate the results of the well-known "Mercado formula" which was the first important contribution made by a Filipino worker on leprosy. This treatment was officially adopted in Culion in 1912; but due to lack of adequate medical supervision, it was considered unsuccessful by some officials. With adequate medical supervision, good results were obtained with the formula. The first ex-lepers released from a leprosarium as bacteriologically positive lepers rendered negative by specific treatment were sent home from the San Lazaro Hospital in Manila in 1912. Later, the same formula was used under different names in many countries.

In the course of time, the Mercado formula was gradually displaced by the ethyl esters of chaulmoogra oil, the clinical applications of which was much improved by the work of Lara and his staff at the Culion Leper Colony. The intradermal or "plancha" method, modification introduced in the colony, was very effective and later was adopted universally. Numerous drugs were also tested for efficacy and safety in treatment of the disease there.

Perkins and Cole made valuable studies on the chemistry and pharmacological action of anti-leprosy drugs at the same colony.

With regard to transmission of and susceptibility to leprosy, some investigation had been made at Culion and important pa-

pers have been written on the subject by Manalang. Concerning its specific etiology, historical experiments have been done by Clegg; subsequently, McKinley, Soule, De Leon, and Pio de Roda published on the same subject.

In the field of pathology, Wade in Culion and Manalang in the San Lazaro Hospital in Manila have made signal contributions on the subject.

As to immunology in leprosy, investigations on the results of the Wasserman test, the Kahn test, and similar tests have been done by Pineda, Arguelles, Monserrat, and others.

The blood chemistry of leprosy had been investigated by Concepcion, Salcedo, and Paras.

Epidemiological studies have been undertaken in Cebu by Rodriguez since 1927 and have been continued by the Leonard Wood Memorial in cooperation with the Philippine Government up to the present time.

In the field of the clinical study of the disease, the contributions made by Gomez, Avellana, and Nicolas in 1922, in which were reported early macular lesions observed among the children born in the colony, who had previously escaped the attention of leprologists, opened new fields in the study of the disease. These studies were continued by Rodriguez, Lara, Chiyuto, and others. Similar lesions were also observed by Rodriguez among adults in the skin clinic at Cebu. Biopsies from patients of Rodriguez in Cebu were later studied by Manalang who was among the first to describe the tuberculoid structure of certain leprotic lesions, leading to the discovery of what is now known as the "tuberculoid type" of leprosy. It is really remarkable that this type, which was unknown and undescribed up to 1930, is now found to be as common as the lepromatous type.

Due to the second World War the workers in the Philippines were late in joining the field regarding the use of the sulfone drugs in leprosy. The first sulfone preparation tried was the well-known Promin originally experimented with at the Carville Leprosarium in Louisiana, U. S. A., in 1942, shortly after the outbreak of the last war. Even after the termination of the war, the Philippine Government did not have enough funds to use these drugs extensively; so the experiments had to be conducted on a limited scale to learn how to use them effectively and safely among Filipino lepers. In the 17th Luis Guerrero lecture delivered at the University of Santo Tomas by him in 1953, Rodriguez summarized the results of his experiments on

treatment in the Philippines. It was reported that Dimethydiaminosulfone preparations, commonly known as DDS are as effective and safe as the other sulfone preparations, with the added advantage that they are much cheaper than any of the latter. The cost of a medicine for a year's treatment is only from five to six pesos a year. Accordingly, these drugs were adopted as the standard treatment in all sanitaria, and after two years the number of released patients who were rendered bacteriologically negative by it increased manifold. Furthermore, investigations at the Leprosy Research and Training Center in Manila have proved that these drugs are also effective and safe to use in mass outpatient treatment.

The discovery of effective and safe as well as cheap medicine is one of the reasons which has led to the adoption of a plan of Traveling Skin Clinics for the early detection and treatment of leprosy in the provinces, particularly in the rural areas. Two pilot units are now in operation in Cebu and Iloilo and many more will be gradually established so as to cover the whole country. Arrangements are being made to dovetail the work of the Rural Health Unit with this program in order that the latter may have a share in the follow-up of the anti-leprosy treatment. When this service becomes adequate, it will lead to the early voluntary presentation of cases of leprosy, and to their treatment in the early favorable stage of the disease. In the course of time, the role of the leprosaria will gradually diminish and a leprosy control program that will be more effective than the present one will be possible.

DIE ERSTEN STÄNDE VON ONCOCEPHALA TUBERCULATA OLIVIER *

Von Erich Uhmann
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EIN TAFEL

Das Material in Alkohol für diese Arbeit wurde mir von Herrn Kollegen Tjoa Tjien Mo in Boger (Indonesien) zum Studium eingesandt. Es wurde an *Ipomoea batatas* gesammelt. Diese Pflanze, die Batate, gehört zu den Convolvulaceæ, Unterfamilie Ipomoeæ. Sie ist eine der wichtigsten Kulturpflanzen der Welt und ist über alle warmen Gegenden der Welt verbreitet. Fast alle *Oncocephala*-Arten, deren Nahrungspflanzen, bisher bekannt geworden sind, werden von *Ipomoea* gemeldet.

Es ist mir nun nicht möglich gewesen, jede Einzelheit zu studieren, z.B. Kopf mit Mundteilen. Ich habe mich darauf beschränkt, diejenigen Teile von Larve und Puppe zu beschreiben und abzubilden, die meiner Erfahrung nach die am leichtesten zu kontrollierenden Eigenschaften haben. Diese sind ohne umständliche Mikropräparate zu sehen. Für die Wissenschaftler des Pflanzenschutzdienstes dürfte die Art meiner Betrachtung fürs erste genügen.

Eier. Die ellipsoidischen, flachen, weisslichen Eier werden ins Innere des Blattes abgelegt. Sie messen etwa 1.1 × 0.5 mm.

Larven. Material: 6 Larven verschiedener Grösse, die grössten 6 × 2.2 mm, die grösste Breite vorm Ende; die kleinsten 5 × 2 mm. Letztere ziemlich parallelseitig. Körper nur wenig abgeflacht, Hinterende etwas nach der Unterseite abfallend.— 13 Blattstückchen mit 10 Larven, die sich verpuppen wollen, in 3 Stückchen haben sie sich eben verpuppt; im Februar, 1954 gesammelt. Die Verpuppung erfolgt in einer blasenartig aufgetriebenen Stelle in den Minen. Die Blase bräunt sich später. Eine Orientierung erlaubt das Material nicht.

Zum Nepianotypus habe ich die grösste, anscheinend verpuppungsreife Larve gewählt. Ihre Farbe ist schmutzig Weiss bis

* 160. Beitrag zur Kenntnis der Hispinæ (Coleoptera: Chrysomelidæ).

hell-oder-dunkelgrau mit hellem Bauchgefäss in der Mitte der Unterseite.—Kopf glänzend, beiderseits mit 5 Ocellen, einer davon unten. Fühler zweigliedrig, auf breiter zylindrischer Basis, letztes Glied mit einem spitzen Fortsatz, ähnlich wie bei Maulik, Proc. Zool. Soc. London (1931) 1159, fig. 16a (*Cœlænomenodera elæidis* Maulik) und loc. cit. (1932) 315, fig. 9c (*Dactylispa rufiventris* Kraatz), ibid. 318, fig. 11b (*Dactylispa chapuisi* Gestro). Oberseite glatt, mit einer vorn abgekürzten Mittellinie, an den Seiten beiderseits des letzten Ocellus und vor der Oberlippe mit je einer kurzen Borste. Oberlippe halbkreisförmig ausgeschnitten.—Pronotum glänzend, seitlich stark konvex, mit feiner Mittellinie, beiderseits mit flachem Eindruck. Mesonotum wie die übrigen Tergite durch mikroskopische Rauhskulptur matt, breiter als das Pronotum, vorn mit tiefer Querlinie und dorso-lateralem Stigma, Seiten stark konvex.—Metanotum ähnlich dem Mesonotum, aber ohne Stigma.—Von den 9 Tergiten haben 1 bis 8 eine seitliche Erweiterung, 1 bis 7 und 9 je ein Paar Stigmen, sodass also im ganzen 9 Paar Stigmen vorhanden sind. Tergit 8 und 9 nicht durch eine Querfurche getrennt. Jedes Stigma am Ende eines sehr kurzen Kreiszylinders. Tergit 1 bis 8 beiderseits in einen kegelartigen Fortsatz ausgezogen, der etwa ein Viertel der Tergitbreite lang ist. Die Fortsätze der Tergite 1, 7 und 8 am schwächsten, die anderen Fortsätze im basalen Teile dick, dann schnell sitzenartig verdünnt mit 2 Börstchen an der Spitze (Tafel 1, fig. 1). Jedes Tergit zwischen den Stigmen mit tiefer Querfurche, die des 8. nur kurz. Tergit 8 und 9 nicht getrennt. Tergit 9 seitlich verbreitert und am Ende breit abgerundet, einer breit-ovalen, kurzen Schaufel vergleichbar. Ihr Hinterrand bei Vergrösserung 50 äusserst fein unregelmässig krenuliert, auf der Schiebe eingedrückt, mit einigen erloschenen groben Punkten, mit erloschenen, radialen Streifen.

Unterseite. Beine (Schreitbeine) gut entwickelt, 2-gliedrig, mit kräftigen, kugeligen Hüften, an der Spitze mit kurzer, kräftiger, gebogener Klaue, daneben beiderseits nach unten zu mit einem fleischigen Lappen. Vom Prosternum bis zum Anus mit einem breiten, hellen, durchscheineneden Gefäss. Sternit 1 bis 7 mit ausgedehnter Querfurche, die besonders in der Mitte vertieft ist und vorn und hinten flache Querwülste hat, die bei der Puppe nicht hervortreten. Sternit 8 + 9 in der Mitte vertieft, dort mit, querovalem Anus. Hinterende des 9. Sternites mit

breiter, flacher Fläche. Die ganze Larven-Oberfläche durch starke Mekroskulptur rauch.

Puppe (Neanotypus). Hellgelblich-weiss, ziemlich flach. 5.5 × 2.8 mm. Grösste Breite am 4. Segment ohne die Anhänge. Oval, am Kopf stark gekrümmt, fast spitz, am Hinterende ziemlich breit abgestutzt.

Oberseite (Tafel 1, fig. 2) Kopf, Halsschild, Deckenscheiden und Metanotum ohne Besonderheiten. Seiten der Tergite verschiedenartig erweitert. Tergit 1 mit einfachem Seitenrand und einem kurzen, dünnen Zylinder, Tergit 2 bis 5 an den Seiten dreieckig erweitert. Auf der abgerundeten Spitze jedes Dreieckes mit einem schwachen Zylinder, der an der Vorderseite der Basis ein winziges Zähnchen hat. Dieses mit einer Endborste, der Hauptzylinder mit zwei kurzen Endborsten. Beim 6. Tergit ist die dreieckige Erweiterung der seiten länger ausgezogen, der Zylinder wird länger und stärker und an der Basis mehr kegelförmig. Dort ist das winzige Zähnchen zu einem kursen Kegel geworden, an dessen Basis ein recht kleines Wärzchen sitzt. Beim Tergit 7 geht die Erweiterung der Seiten direkt in den Anhang über, der ähnlich wie der des 6. Tergites gestaltet ist. Das Wärzchen ist höher hinauf gerückt. Beim 8. Tergit ist die Erweiterung schmäler, zweiteilig, ohne Wärzchen. Die Erweiterungen des 9. Tergites zeigt die Abbildung 2. Die beiden Endtergite sind miteinander verschmolzen. Alle Anhänge mit gröberer Rauhskulptur als die sonstige Oberseite. Tergit 1 bis 6 mit einer Querfurche, die auf dem 4. und 5. Tergit am stärksten entwickelt ist. Die erhabenen Ränder der Furchen sind mit vielen winzigen, knopfartigen, glänzenden, wenig auffallenden Buckelchen besetzt. Tergite 7 und 8+9 fein gerunzelt. Tergit 1 bis 5 mit je einem Stigmenpaar, die der ersten 4 Tergit wie gewöhnlich. Die Stigmen des 5. Tergites haben eine noch nicht beobachtete Bauart. Ein Stigma besteht aus einem 0.88 mm langen, klaffenden, breiten Spalt, der seitlich nach aussen offen ist, Mit seinem freien Ende ragt das Gebilde schräg über die Seiten der Puppe heraus, sodass es auch auf der Unterseite sichtbar ist, etwa bis zur Hälfte des Anhanges des 6. Tergites. Das Stigma entspringt einer breiten, ovalen Basis. Die Oeffnung sitzt auf einer zylinderartigen Erhebung.

Unterseite. Hier fällt spitz zulaufende Kopf besonders auf. Fühlerscheiden mit schwach angedeuteter Segmentierung. Scheiden der Decken ohne Rippen, ihr Hinterrand breit abgest-

utzt, Innenwinkel fast rechtwinklig, Aussenwinkel abgerundet. Sternite ohne Besonderheiten.

Auffällig ist die fehlende Beborstung, die schwachen Borsten an den Anhängen der Segmente sind sehr fein. Die ganze Puppen-Oberfläche hat eine rauhe Mikroskulptur, die auf den Anhängen besonders deutlich ist.

Ueber die ersten Stände asiatischer *Oncocephala*-Arten habe ich noch nichts gefunden. Biologische Notizen liegen da nur vor über O. *angulata* Gestro. Sie lebt an Orchideæ. Koningsberger erwähnt in Java Zoolog. Biol. **12** (1911–15) 127 die Wirtspflanze zuerst. In der Folgezeit wird sie auch von anderen Autoren-aufgeführt. *O. tuberculata* Olivier wird zuerst von Maulik als an *Ipomoea* lebend erwähnt: Fauna Brit. India, Hispinæ und Cassidinæ (1919) 101: Madras: Coimbatore, June 1913, on sweet potato (Ramakrishna). Es muss aber noch geklärt werden, ob die *O. tuberculata* Maulik's die *O. tuberculata* Olivier's ist.

Ueber die ersten Stände von *Oncocephala*-Arten Afrikas hat meines Wissens nur Risbec geschrieben und Abbildungen dazu gegeben in: "Travaux du Laboratoire d'Entomologie du Secteur Soudanais de Recherches Agronomiques, 1, 2 e trimestre 1950, Dakar, 304–306, fig. 130, nr. 1179: Imago; nr. 1180, 1181: Unter- und Oberseite der Puppe; nr. 1182; Larve; nr. 1183; Puppe in der Mine; nr. 1184; Seitenanhang des Abdomens der Larve. Alle Abbildungen beziehen sich auf *O. senegalensis* Guérin.

An Stelle von Beschreibungen verweist Risbec auf die Abbildungen. Aus diesen geht hervor, dass (*1*) bei der behandelten Larve die Tergite 8 und 9 getrennt sind; (*2*) dass auch bei der Puppe die Segmente 8 und 9 getrennt sind, und das ihre Seitenanhänge anders gestaltet zu sein scheinen. Die Spitze des 9. Segmentes ist bei *O. senegalensis* und *O. tuberculata* zwar ähnlich, aber doch verschieden: Die Spitze ist bei *O. tuberculata* von den lappenartigen Seitenanhängen durch tiefe Einschnitte deutlicher abgetrennt.

Das 9. Tergit der Larve ist bei beiden Arten recht ähnlich. Die genaue Bildung des Stigmenpaares auf dem 5. Tergit der Puppe von *O. senegalensis* lässt sich aus der Abbildung nicht ersehen. Die Stigmen scheinen aber deren der *O. tuberculata* ähnlich zu sein.

Die Synonymierung *O. senegalensis* Guérin = *gestroi* Weise, die Risbec vorgenommen hat, ist meiner Erfahrung nach nicht richtig.

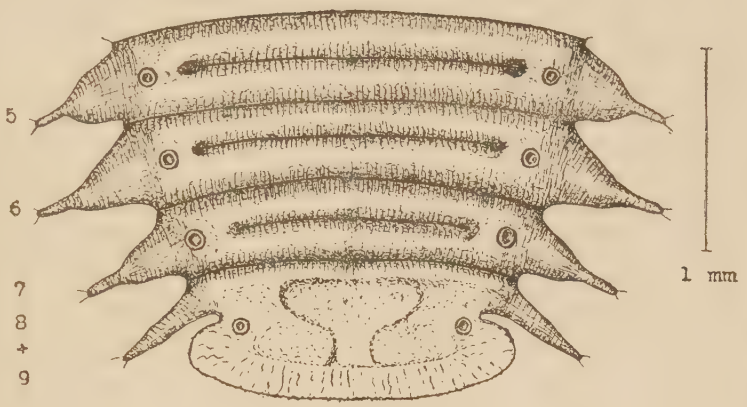
Ein zweites Mal schreibt Risbec in Rev. Int. Bot. Appl. **30** (1950) 392– über denselben Gegenstand, aber etwas kurzer und ohne Abbildungen.

ABBILDUNGEN

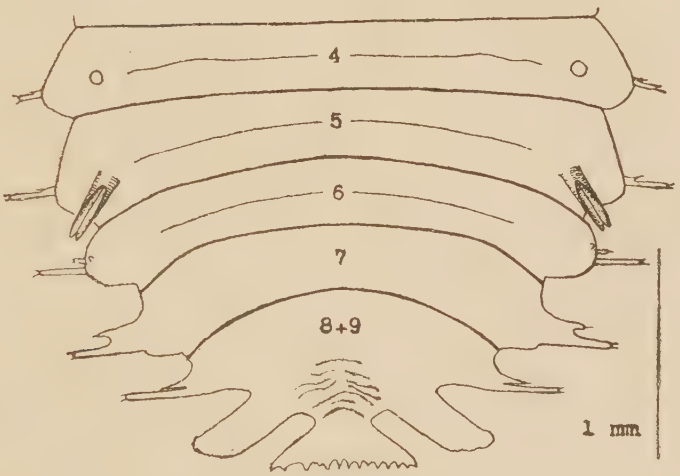
Tafel 1

Fig. 1. Tergit 5 bis 9 des Nepianotypus.

2. Tergit 4 bis 9 des Neanotypus. Von der Skulptur sind nur die Anhänge der Tergite gezeichnet, ferner die Stigmen des 5. Tergites. Die Furchen der Tergite sind nur angedeutet.



1



2

TAFEL 1.

HISPINÆ AUS INDONESIA, III*

Von Erich Uhmann
Stollberg-Sachsen, Lessingstr. 15

ZWEI TEXTFIGUREN

Im Laufe der Jahre hat mir ein reiches Studienmaterial von Hispinæ aus Indonesia vergelegen. In einer ganzen Reihe von Arbeiten habe ich darüber berichtet.

Besonders wertvoll waren für meine Studien die Hispinen, die in Zoologischen Museum der Humboldt-Universität in Berlin aufbewahrt werden. Sie ermöglichten es, wichtige Einblicke in die Werwandtschaft einiger indonesischer Arten zu tun von denen bisher nur die Einzelbeschreibungen vorlagen.

1. DACTYLISPA PERROTETII Guérin. **Fig. 1 and 2.**

Es sind vier typen borhanden, die aus der Sammlung Guérin eingetauscht worden sind (Kat. Nr. 28409). Bezettelt: *Perrotetii* Guér., Nila Giri Guér. Ein Stück von diesen habe ich zum Lectotypus gewänht. Ferner ein Stuck: Nilgiri Hills (Andrewes), Weise coll. et det. Bei diesen fünf Stücken sind die Seitenranddornen der Decken alle fast gleich lang und gleichgestaltet. Wenn ein kürzerer auftritt, so ist sein Unterschied zu den normalen nicht sehr gross.

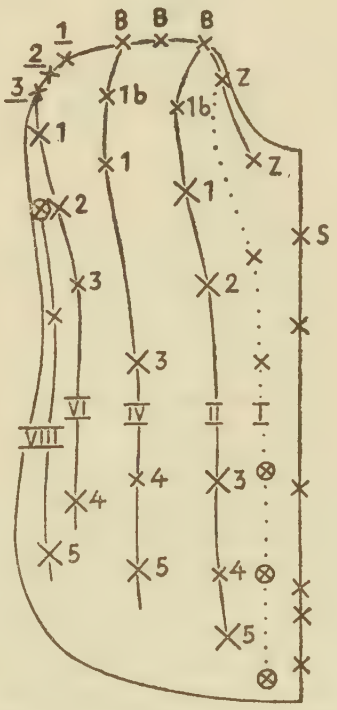


Fig. 1. *Dactylispa perrotetii* Guérin.

Mit diesen Stücken stimmen meine drei Typen von *D. xanthospila* ab. *picipes* Uhmann [Treubia 15 (1935) 149] aus Java überein bis auf die Bedornung des Decken-Seitenrandes. Heir wechseln sehr lange mit sehr kurzen Dornen regelmässig ab. Bei einem vierte javanischen Stück fällt auf einer grösseren Strecke diese Regelmässigkeit weg, und es sind nur lange Dornen ausgebildet. Gerade jetzt habe ich Material aus Java und Sumatra erhalten, bei dem der Wechsel zwischen Kurzen und langen Dornen bald

* 173. Beitrag zur Kenntnis der Hispinæ (Coleoptera: Chrysomelidæ).

regelmassig erfolgt, bald die kurzen Dornen fehlen, bald Asymmetrie hierin vorhanden ist. Es muss *D. xanthospila* ab. *picipes* Uhmann als identisch mit *D. perrotetii* angesehen werden. In meiner kurzen Beschreibung (*loc. cit.*) füge hinzu, dass die ganze Oberseite tief schwarz und glänzend ist.

Weise führt in seinen katalogen noch Borneo und die Philippinen als Heimat an. Bei Borneo bezieht er sich vielleicht auf die Stücke seiner Sammlung, die ich anschliessend bei *D. malayana* Gestro erwähne. Für die Philippinen enthält seine Sammlung keine Belegstücke und auch Schultze bringt in seinem "Catalogue of Philippine Coleoptera" (1915) 105 nur den Namen ohne Fundangabe. Vielleicht liegt ein Versehen vor durch das Stück, seiner Sammlung, das mit Borneo (Mus. Manila) bezettelt ist. Es ist die Angabe "Philippinen" zu streichen, auch bei Maulik, Fauna Brit. India, Hispinæ und Cassidinæ (1919) 181.

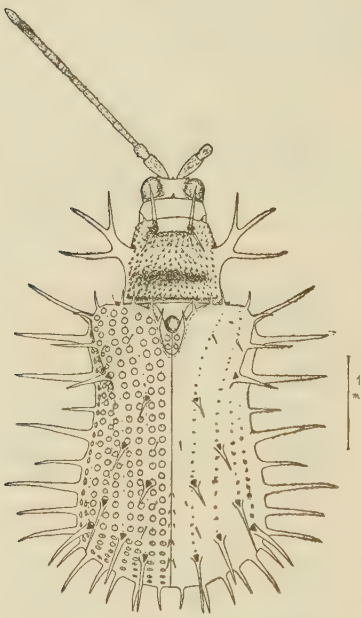


FIG. 2. *Dactylispa perrotetii* Guérin.

Zu *D. perrotetii* stelle ich auch als Chromation mit gelbbraunen Beinen *D. malayana* Gestro auf Grund eines Stückes von SO-Borneo (Grabowsky S), das sehr gut zur Beschreibung passt. Mit diesem stimmen ein zweites gleicher Herkunft und eins von West-Borneo (Dr. Will), coll. Hauser, fast überein, das Gelbbräunliche der Unterseite und der Beine ist aber viel dunkler. In coll, Weise stecken noch vier Stücken von Borneo: Kina Balu (Staudinger), 106199, die letzteren gleichen und von Weise als *D. trifida* Chapuis, angesprochen worden sind. Drei weitere gleiche Stücke von Kina Balu und das aus Borneo (Mus. Manila) der coll. Weise hat Weise unbestimmt gelassen. Sie gehören aber hierher. Die Stücke mit den dunklen Beinen gleichen ganz den typischen Stücken der *D. perrotetii* aus der coll. Guérin.

Beschrieben hat Gestro die *D. malayana* von Borneo: Kutcing. Weise sah Stücke ebendaher und von Java: Noesa Kambangan (Drescher leg.). Aus letzterer Ausbeute habe ich auch Material. Maulik führt als fraglichen Fundort in Proc. Zool. Soc. London (1916) 575 die Malayen-Halbinsel an. Dort wird sie wohl vorkommen. Ich selbst sah Stücke von der üblichen Fundgegend auf Borneo: Quop [Ann. Mag. Natr. Hist. (11) **1** (1938) 427].

2. **DACTYLISPA TRIFIDA** Chapuis.

Aus Malacca beschrieben. Gestro erwähnt die Art in Ann. Mus. Stor. Natr. Genova (2) **2** (1885) 176 von Java und Sarawak. Die javanischen Stücke dürften meiner *D. xanthospila* ab. *picipes* entsprechen und die aus Sarawak der *D. malayana* mit schwarzen Beinen. Weiter führt Gestro, *loc. cit.* **38** (1897) 92 ausserden noch Sumatra auf, davon eins mit bräunlichem Halsschild. In Bull. Mus. R. Hist. Natr. Belg. 2 **10** (1934) 3 habe ich eine ergänzende Beschreibung des Typus von *D. trifida* gegeben. Auf der vorletzten Zeile muss es dort heissen statt "4. Reihe" "4. Raumes." Die Dornen der Deckenscheibe sind wie bei *D. perrotetii* angeordnet. Ich halte *D. trifida* für identisch mit *D. perrotetii.*

3. **DACTYLISPA BRUNNIPES** Motschulsky.

Diese aus Batavia beschriebene Art ist anscheinend über alle Sunda-Inseln verbreitet. Sie ändert stark in der Farbe ab, ähnlich wie die afrikanische *D. pubicollis* Chapuis. Die Nominatform ist glänzend schwarz mit gelbbraunen Beinen, die Rückendornen des Halsschildes und einige unbestimmte Flecken auf den Decken sind mehr oder weniger braun. Ein Stück, das dieser Färbung gabe entspricht, steckt in meiner Sammlung aus Java: Malang, Idjen-Geb. (Koller leg.). Besonders die gelbbraune Färbung der Basis der Vorderrand-Dornen des Halsschildes ist charakteristisch. Mit meinem Stück stimmen im Berliner Material noch zwei Stücke aus Java, 106209, coll. Weise überein, die Weise auch als *D. brunnipes* bestimmt hat.

Ich stelle *D. brunnipes* als Chromation zu *D. perrotetii.* In meiner Sammlung habe ich zahlreiche Stücke aus Java, an denen man verfolgen kann, wie auf dem ursprünglich ganz schwarzen Decken erst unbestimmte, dunkelbraune Stellen zwischen den Dornen auftreten. Diese Stellen hellen sich allmählich auf und breiten sich weiter aus, bis schliesslich die Decken gelbbraun werden. Sie erscheinen dann durch die verdickte schwarze Basis der schwarzen Dornen schwarzgefleckt. Solche Stücke

habe ich [Treubia 15 (1935) 149] als *D. xanthospila* Gestro bestimmt. In den Aufhellungsprozess werden auch der Halsschild und sogar die Fühler einbezogen (siehe *D. flavolimbata* Gestro). Bei dieser Betrachtungsweise ist die Nominatform als die ursprüngliche vorausgesetzt. Es ist aber durchaus möglich, dass die Dinge gerade umgekehrt liegen, die Nominatform also das melanistische Endglied wäre. In Treubia 17 (1939) 42 schrieb ich schon, dass ich alle von mir bisher als *D. xanthospila* angesprochenen Stücke aus Java für *D. brunnipes* halte.

Für die hellste Chromation halte ich zwei Stücke aus Celebes: Pangie [C. Ribbe (1882)] Oberseite dunkel gelbbraun, Scheibendornen der Decken schwarz mit kaum geschwärzter Basis, Randdornen braun, zur Spitze dunkel, Brust und Bauch schwarz. 7. bis 11. Fühlerglied angedunkelt.

Ob *D. xanthospila* Gestro aus Birma auch als Chromation zu *D. perrotetii* gestellt werden muss, kann erst nach dem Studium des einzigen Stückes, das Gestro vorlag, entschieden werden (siehe auch weiter unten).

4. DACTYLISPA FLAVOLIMBATA Gestro.

1, Perak (Staudinger). Weise coll. et det., Stück passt genau zur Beschreibung, es fehlen ihm also die kurzen Dörnchen zwischen den Seitenrand-Dornen der Decken. Diese Art halte ich für eine besonders auffallende Chromation von *D. perrotetii* mit ganz gelbbraunem Halsschild und Fühlern, die von vier Glied ab gelbbraun sind. Ihr Vorkommen auf Java und Sumatra ist wahrscheinlich.

Sonst sind die Fühler der Chromationen dunkel, nur ein Stück meiner Sammlung aus Java hat sie granz gelbbraun.

Variabilitätsbreite der *D. perrotetii* Guérin. Halsschild mit zwei meist tiefen Querfurchen, eine hinter den Vorderrand-Dornen, die andere hinter der Basis der Seitenrand-Dornen. Die Zwischenfläche ist meist deutlich gewölbt. nur bei zwei Stück der hellen Chromation fasteben. Wölbung meist glatt, oft teilweise bis ganz punktiert. Hinter der Basis der Seitenrand-Dornen ein mehr oder weniger tiefer, rundlicher, punktierter Eindruck, der innen von einem mehr oder weniger deutlichen Fältchen oder Kielchen begrenzt wird. Dornen des Halsschildes zuweilen mit kleinen Neb endörnchen. Jeder der Nabelpunkte mit einem Härchen, das manchmal abgerieben ist.

Deckenelemente. (Fig. 1). Punktreihen durch die verdickte Basis der Dornen und im Eindruck etwas gestört. Sechste

Reihe durch einige Punkte auf der Schulter angedeutet. Seibente Reihe bis zum Eindruck deutlich. Neunte und zehnte in der Mittee vereinigt, Alle Zwischenräume flach. Dornen siehe Fig. 1, die den Grundplan der Bedornung der vier Stück aus coll. Guérin wiedergibt. Seitenrand-Dornen bei diesen Stücken lang, nicht mit Dörnchen abwechselnd, was beim übrigen Material der Fall ist.

5. DACTYLISPA XANTHOSPILA Gestro.

Beschrieben in Ann. Mus. Stor. Natr. Genova **30** (1890) 261. *Loc. cit.* **38** (1897) 91 erwähnt Gestro ein kleineres, in der Färbung etwas abweichendes Stück von Sumatra. Vielleicht eine kleine chrom. *brunnipes* Motschulsky. Weise erwähnt, in Dtsch. Ent. Z. (1897) 131 ein Stück aus Birma: Prome, das seine gelben Seitenrand-Dornen anden Decken hat, und bei dem die Spitzen der Dornen des Halsschildes nicht breit schwarz gefärbt sind. Maulik, Fauna Brit. India, Hispinæ und Cassidinæ (1919) 200 führt fünf Stücke aus Birma an, die er zwei Aberrationen zuteilt. Bei diesen tritt das Schwarz mehr zurück als beim Typus. Zu Uhmann, Misc. Zool. Sumatrana **54** (1931) 3. Das Stück von Banka gehört zur chr. *malayana* Gestro, die anderen vier zur chrom. *brunnipes* Motschulsky, Bull. Mus. R. Hist. Natr. Belg. (1934) 1–. Das dort besprochene Material von Java gehört zur chrom. *brunnipes,* das von Annam und Malakka halte ich wie alle aus Hinterindien erwähnten Stücke für echte *D. xanthospila.* Diese Art weist also starke Farbabänderungen auf. Ob *D. xanthospila* eine Chromation von *D. perrotetii* Guérin ist, muss erst das Studium des Typus ergeben. Im Berliner Museum steckt ein Stück aus Tonkin: Dap Can (Sicard), coll. Weise. Er hat es als *brunnipes xanthospila* bezettelt. Die mir vorliegenden hinterindischen Stücke meiner Sammlung, 2, Annam: Phuc-Son und 1, Tonkin: Lao Kay, sind klein, 3.5 mm. Sie haben im Verhältnis zum Körper kürzere Decken, sind also nicht so schlank wie die von den sunda-Inseln. Vielleicht liegt hier ein grundlegender Unterschied zwischen *D. perrotetii* und *xanthospila* vor.

In meinem Beitrag Bull. Mus. R. Hist. Natr. Belg. (2) **10** (1934) 1 muss es auf Zeile 20 der Besprechung statt "6" "5" heissen.

6. DACTYLISPA FLAVOMACULATA Uhmann.

Beschrieben, Ent. Bl. **26** (1930) 133–, fig. 4, erwähnt in Bull. Mus. R. Hist. Natr. Belg. (2) **10** (1934) 1–, ist zu streichen in

Stettin. Ent. Ztg. 92 (1931) 225–. Diese ebenfalls farbveränderliche Art ist mit *D. xanthospila* sehr nahe verwandt, mit ihr oder mit *D. perrotetii* vielleicht identisch.

7. DACTYLISPA SETIFERA Chapuis.

Vergleiche auch Bull. Mus. R. Hist. Natr. Belg. (2) 10 (1934) 3 und *loc. cit.* (26) 15 (1939) 7, fig. 6.

Sieben Stücke Süd-Celebes: Bantimurang (C. Ribbe, 1882); Panje (id.). Weise hat sei als *D. spinosa* Web. bestimmt. Ausserdem 1 St. Tonkin: Ha-Lang, coll. Weise. Ob Fundort richtig?

Deckendornen wie in Bull. Mus. R. Hist. Natr. Belg. (26) 15 (1939) 8, fig. 6 abgebildet. Reihe 1 bis 8 regelmässig, 9 mit 10 in der Mitte verschmolzen. An obigen Material und dem meiner Sammlung sieht man deutlich, dass die Reihen 9 und 10 am Hinterrand der Decken entlang laufen und sich mit Reihe 2 und 1 vereinigen: 1 mit 10 und 2 mit 9. Behaarung. Die besonders dichte, auffällige Behaarung setzt sich aus der gewöhnlichen und einer zusätzlichen zusammen. Die gewöhnliche entspringt den Querwänden der Pnnkte: jede Querwand trägt ein mehr oder weniger niederliegendes Härchen über jedem Punkte. Die zusätzliche befindet sich erstens auf den Zwischenräumen, wo jedes Härchen aufrecht auf einem kleinen Körnchen sitzt. Die Zusatzbehaarung ist länger als die normale. Die Verteilung der Körnchen ist nicht ganz regelmässig, doch kann man rechnen, dass jede Kreuzung einer Querwand mit einem Zwischenraum ein Körnchen trägt, auch sind noch zusätzliche da. Die 2. zusätzliche Behaarung sitzt etwas unterhalb jeder Dornenspitze.— Schenkel mit Dörnchen.

VERZEICHNIS MEINER BEITRÄGE ÜBER HISPINÆ AUS INDONESIA

8. Hispinen aus einer Sendung des Buitenzorg-Museums, Java. Treubia 10 (1928) 61–63, 1 fig.

11. Fauna sumatrensis (Beitrag Nr. 57), Hispinæ. Ent. Mitt. 17 (1928) 370–375, fig. 1–4.

12. Fauna sumatrensis (Beitrag Nr. 58), Hispinæ. Ent. Mitt. 17 (1928) 393–398.

14. Hispinen von den Sunda-Inseln. Z. Wiss. Ins. Biol. 24 (1929) 143–149, fig. 1–3.

15. Hispinen von Sumatras Ostküste gesammelt von Herrn Dr. L. Fulmek, nebst biologischen Bemerkungen über zwei bekannte Arten. Misc. Zool. Sumatr. 41 (1929) 1–3.

16. Neue Hispinen der Sunda-Inseln. *Loc. cit.* 43 (1930) 1–6.

17. Bestimmungstabelle der Dactylispa-Arten mit 4 Halsschild-Seitendornen aus der indo-malayischen Region. *Loc. cit.* 46 (1930) 1–3.

27. Hispinen aus dem Holländischen Kolonialgebiet. Zool. Mededeelingen 13 (1931) 178, 179, fig. 1.
31. Hispinen aus Sumatra. Misc. Zool. Sumatr. 54 (1931) 1–4.
37. Ueber 3 Hispinen von den Molukken und den Salomonen Fol. Zool. Hydrob. 4 (1932) 13–15.
44. Zwei von S.K.H. dem Prinzen Leopold von Belgien im Jahre 1932 in Niederländisch-Indien gesammelte Hispinen nebst Bemerkungen über Typen aus der Sammlung Chapuis. Bull. Mus. R. Hist Natr. Belg. 10 (1934) 1–6.
46. Hispinen aus Sumatra, II. Misc. Zool. Sumatr. 86 (1934) 1–3.
53. Hispinen aus Java und Sumatra, hauptsächlich gesammelt von Herrn F. C. Drescher. Treubia 15 (1935) 141–150.
78. Hispinen von Java aus der Sammlung des Herrn F.C. Drescher. Treubia 17 (1939) 37–43, fig. 1.
80. Dr. E. Mjöberg's zoological collections from Sumatra. 14. Hispinæ. Ark. Zool. 31 B (1939) 1–5, fig. 1.
83. Dactylispa discoidalis Chapuis und Verwandte. Bull. Mus. R. Hist. Natr. Belg. 15 (1939) 1–12, fig. 1–8.
111. Puppe und Larve von Callispa duodecimmaculata Chapuis. Tijdscher, Ent. (49) 90 (1947) 54–56, fig. 1, 2.
141. Hispinæ aus Java. Idea 9 (1953) 89–91.
157. Die Puppenhäute zweier Dactylispa-Arten aus Java. Idea 10 (1955) 53–56.
159. Austral-asiatische Hispinae aus dem Zoologischen Museum der Humboldt-Universität in Berlin, 4. Teil. Dactylispa spinosa Weber. Mitt. Zool. Mus. Berlin 31 (1955) 11–15. fig. 1, 2.
164. Hispinæ aus Indonesia I. Teil. Tijdscher. Ent. 98 (1955) 133–146, fig. 1–15.
170. Hispinæ aus Indonesia. (II. Teil). Beaufortia 5 (1956) 61–72, fig. 1–7.

IM DRUCK

160. Die ersten stände von Oncocephala tuberculata Olivier. Treubia.

67174——7

ABBILDUNGEN

Textfiguren

Fig. 1. Schema der Dekenelemente auf der linken Decke der 4 typischen Stücke von *Dactylispa perrotetii* Guérin.

I, II, IV, VI, VIII; (Ziwschen) räume. Sie sind flach und treten kaum hervor.

Das Schema deutet die Lage und relative Grösse der Dornen an. Die Kreuzchen auf den Räumen zeigen Dörnchen an, die an anderen Sücken fehlen können. Ein Kreuzchen in einem Kreis bedeutet einen Dorn oder ein Dörnchen, die noch zusätzlich auftreten können.

B: Basaldörnchen S: Schliessdörnchen.

Z: Schildchen-Zusatzdörnchen.

1, 2, 3, 4, 5: die einzelnen Dornen auf den Räumen

*1, 2, 3*Á Achseldornen

1 b: Dorn basalwärts von 1.

VI 2, der Folgedorn, ist in Wirklichkeit näher an Raum IV herangerückt und gehört jhm scheinbar an.

2. *Dactylispa perrotetii* Guérin. Oberseite des Paratypoides meiner Sammlung. Die Bedornung der Decken ist etwas spärlicher als bei den anderen Typen (Fig. 1). Es fehlen: S, II 1 b, IV 1 b, IV 4, VI *3*. Auf Raum VIII ist nur VIII 5 entwickelt. Die Grunddornen sind bei diesem Stück alle fast gleich. Ihre Grösse und Stärke ist durch die Gestaltung einer jeden Basis angedeutet. Die Doren II 5, IV 5. VIII 5 geben die natürliche Gestalt wieder. Vom rechten Fühler sind nur die beiden Basalglieder erhalten.

NOTES ON ONCOCEPHALA TUBERCULATA (OLIVIER) (COLEOPTERA: HISPIDÆ)

A LEAFMINER OF SWEET POTATO (IPOMŒA BATATAS POIR.) IN WEST JAVA

By Tjoa Tjien Mo
Bogor, Indonesia

ONE PLATE

These notes are to be considered as a supplement of the article of Erich Uhmann, entitled "Die ersten Stände von *Oncocephala tuberculata* Olivier."

So far the species in question is known only from India and West Java. In India, like in West Java, the insect lives on *Ipomoea* species: viz., on *I. batatas* (Bombay) and *I. sepiaria* (Coimbatore). Its biology in Coimbatore, which has been observed and briefly described by Cherian and Menon (1940), apparently does not deviate much from that in West Java.

Early July, 1953, during investigation for the further completion of the present knowledge about sweet potato insects in Indonesia, it was found that many sweet potato leaves in some gardens at Tjibelagung (West of Bogor), showed broad mines. These mines were caused by larvæ of a hispid, identified by E. Uhmann as *Oncocephala tuberculata* (Olivier).

In 1953, this beetle was more numerous than usual on sweet potatoes in the above-mentioned area. Evidently it had not been noticed before. A further check indicated that *Oncocephala* infestation had been limited to the sweet potato gardens to the West area of Bogor.

The typical flat beetles (Plate 1, fig. 1), 4.8 to 5.1 mm long and 2.8 to 3 mm wide, are as a rule colored irregularly brownish yellow and black, thus giving the impression of being black with many yellow dots and spots placed at random. They do not shun the light and are often found on either the upper or nether side of the sweet potato leaves in the morning hours, also in copula. In feeding they scrape away the leaf pulp on the upper side of the leaf as far as the lower epidermis, which then becomes visible as transparent stripes, 0.75 to 2 mm in width, of which the length sometimes is 15 mm (Plate 1, fig. 6).

The flat pear-shaped eggs (Plate 1, fig. 2), which have a length of 1 to 1.22 mm and a width of 0.5 to 0.7 mm, are deposited simply on the upper side of the leaves that are more or less whole and not yet damaged by the same species. In thirty-eight laboratory observations, 34 eggs were deposited near the margin of the leaves and four eggs near the center. The eggs are pressed into the pulp in such a way that nothing protrudes from the surface of the leaves (Plate 1, fig. 2). To the naked eye they looked like tiny brown discolorations of the leaf, being more or less oval spots, pointed at one side.

The newly hatched pale yellow larvæ (Plate 1, fig. 3), about 0.7 mm long, straight-away bore into the pulp and while eating make an irregular mine until they are fully grown. Later on the remaining epidermis on the upper side of the leaf discolors brown to black-brown (Plate 1, fig. 7).

The first part of the mine is 0.5 to 1.5 mm wide and later on widens to 2 to 6 mm or more. Often the turning and twisting parts of the mine go parallel or join and then may become 16 to 20 mm wide (Plate 1, fig. 8). The length of a mine is from 5.5 to 10 cm. One mine is usually limited to one-half of a leaf. Occasionally this mine crosses the central vein to the other half of the leaf. In either half of a leaf seldom more than one larva is found. The black excrement is clearly visible in the middle of the mine, sometimes in a row, once in a while in little lumps or else scattered.

The flat yellowish to light brown fully grown larvæ (Plate 1, fig. 4), which have a length of 6 to 7 mm and a width of 2 to 2.2 mm leave their mines and move over to the other half of the leaf or to a neighboring leaf. On the lower side of the leaf they cut out a straight piece of the epidermis to a length of ± 3 mm without damaging the upper epidermis. Through this hole the larva wriggles inside, cutting as it goes, which takes 15 to 25 minutes. In 67 cases the larvæ entered the leaf from the nether side and in 2 cases from the upper side. After going through a prepupal stage of a few days, the larva inside the sac (Plate 1, fig. 9), just described, changes into a flat broad light yellowish pupa (Plate 1, fig. 5). The length is 5.5 to 6 mm and the width 2.7 to 3 mm. Many pupal sacs found on the upper side of the leaf are chocolate brown, while those on the nether side withered brown color.

The egg stage lasts 7 to 11 days, mean 8 days (48 observations), the larval stage 12 to 23 days, mean 16 days (23 observa-

tions), the prepupal stage 3 to 5 days, mean 4 days (20 observations), and pupal stage 5 to 9 days, mean 6 days (16 observations). The life cycle of 16 individuals was observed and found to last 27 to 51 days, with a mean of 34 days. In Coimbatore the life cycle lasts 32 to 48 days. In the laboratory at Bogor these observation were made with the broad-leaved sweet potato: viz., the Gedang variety as well as with the palmate Rachik. Apparently the size of the leaves does not influence the time for the development of the hispid larva.

The mines are mostly found on broad-leaved varieties, such as Gedang and Mantang. The varieties with narrow palmate leaves, such as Rachik, are as a rule avoided, as long as broad-leaved varieties are available to the insects.

From the pupæ of this hispid two species of parasites have been obtained: viz., *Stirobracon* sp. nov., a braconid (det. Mr. C. F. W. Muesebeck, 1953, Plate 1, fig. 10) and *Sympiesis femoralis* (Zehntner) and eulophid (det. Dr. B. D. Burks, 1953).

Stirobracon sp. nov., is 2.2 to 2.5 mm long. The head and thorax are brown and the abdomen light yellow-brown with a light spot on the dorsal side. One *Oncocephala* pupa harbors one to four parasites (Plate 1, fig. 11). From 168 *Oncocephala* pupæ only eight, or 4.8 per cent were parasitized.

Sympiesis femoralis (Zehntner) is a tiny black parasite, 1.5 to 2 mm long. These wasps are of little importance.

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ILLUSTRATIONS

Plate 1

Fig. 1. *Oncocephala tuberculata.* Adult (6x).
2. Egg, inserted in the tissue of a leaf (10x).
3. Young larva (43x).
4. Fullgrown larva (5x).
5. Pupa, dorsal view (5x).
6. Leaf injured by beetle (¾x).
7–8. Mines (¾x).
9. Pupal sac (1x).
10. *Stirobracon* sp. nov. (14x).
11. *Oncocephala* pupal sac showing four exit-holes of *Stirobracon* wasps (3x).

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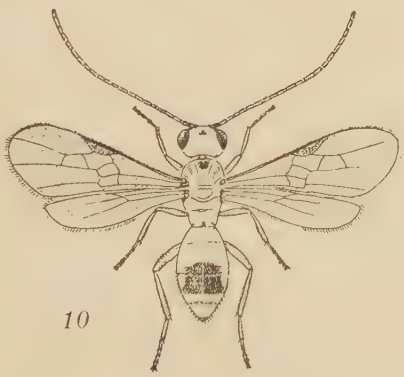
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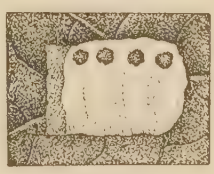
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PLATE 1.

PHONOLOGY OF THE GUHANG IFUGAO DIALECT

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INTRODUCTION

The Ifugao dialect is spoken by over fifty thousand speakers living in a rice terrace culture in the Ifugao subprovince, Mountain Province, Philippines. This major linguistic group may be subdivided into several distinct but closely related dialects, which vary for the most part in subphonemic variations of pronunciation and in some lexical terms. This phonological analysis was made of the Guhang dialect which varies only slightly from the Banaue Central dialect and may be considered as part of the larger Banaue dialect which consists of an estimated three thousand speakers.

Anthropological and linguistic studies have already been conducted in the Ifugao region by such outstanding scientists as H. Otley Beyer, Roy F. Barton, Father Francis Lambrecht, C.I.C.M., and others. It is hoped that this paper may in a way add to the wealth of material already gathered.

The principal informant used in the preparation of this paper was Lourdes Numbanal of the village of Guhang. She was approximately eighteen years old and had completed two years of high school training. Besides her native dialect, she spoke both English and Ilocano. Except for two years of schooling in Baguio she had lived all her life in the village of Guhang.

The materials used in this paper were gathered during the years 1954 to 1955 under the auspices of the Summer Institute of Linguistics.

PHONEME

There are nineteen segmental phonemes and one suprasegmental phoneme in the Guhang, Ifugao dialect. The segmental phonemes are *p, b, t, d, k, g, ʔ, m, n, ng, l, h, y, w, i, e, a, u, and o.* There is a suprasegmental phoneme of stress.

1.1. Phonemic contrasts, including segmental and prosodic features, are listed below. These include contrasts between phonetically similar phonemes, between single and geminated consonants and vowels and contrasts in stress placement.

PHONEME CONTRASTS

1.1.1. /b/vs/p. [pfáhɔ^r] /báhol/ 'fault, sín', [páhɔ^r] /páhol/ 'spear [generic term]'; [pfutúŋgɔ^n] /butúngon/ 'put in [betel nut bag]', [putuŋgɔ́^n] /putungón/ 'break'; [ʔʌ́rtipf] /ʔáltib/ 'scissors', [ʔʌ́ttɩp] /ʔáttip/ 'a kind of water bug'.

1.1.2. /d/ vs /t/. [hápid] /hápid/ 'leaf used in chewing', [háp ɩt] /hápit/ 'speech'; [ʔɔ́^dnʌn] /ʔódnan/ 'hold [by hand]', [ʔ ɔ́tnʌn] /ʔótnan/ 'place on top of'; [ʔipʌ́dtšʉŋg] /ipáddung/ 'compare', [ʔipʌ́ttšʉŋg] /ʔipátdung/ 'allow to shelter'.

1.1.3. /d/ vs /l/. [ʔʌtšánʌ] /ʔadána/ 'where?', [ʔʌlánʌ] ʔalána/ 'he gets'; [ʔʌtší] /ʔadí/ 'will not', [ʔʌlí] /ʔalí/ 'voice'; [pfɔ^dpfɔ́^tš] /bodbód/ 'bundle', [pfɔ^rpfɔ́^r] /bolból/ 'pine tree'; [ʔitšʌ́t] /ʔidát/ 'give', [ʔilʌ́t] /ʔilát/ 'light'; [pfutšɛ́ˑŋg] /budéng/ 'rice bird', [pfulɛ́ˑŋg] /buléng/ 'earth worm'; [mʌtšʌmɔ́^ t] /madamút/ 'heavy', [mʌlʌmɔ́^ t] /malamút/ 'many roots'; [ʔitšúur] /ʔidúul/ 'share food', [ʔʌlúur] /ʔalúul/ 'bark of dog'.

1.1.4. /g/ vs /k/ vs /ʔ. [tšílʌk] /dílag/ 'light', [tšílʌʔ] /díla?/ 'my tongue', [ʔálʌk] /ʔálak/ 'irrigation canal'; [táku] /tágu/ 'person', [tákᵤu] /táku/ 'dipping bowl', [tɔ́^ʔɔ^] /tóʔo/ 'mouth'.

1.1.5. /b/vs/bb/.[1] [ʔípfʌ]/ʔíba] 'sibling', [ʔíbpfʌ] /ʔíbba/ 'companion'.

1.1.6. /m/ vs /mm/. [ʔámʌ] /ʔáma/ 'father', [ʔʌ́mmʌ] /ʔámma/ 'maker'.

1.1.7. /ng/ vs /ngng/. [páŋgɾ] /pángel/[2] 'chin', [pʌ́ŋgŋgɾ] /pángngel/ 'half'.

1.1.8. /w/vs/ww/. [ʔíwʌŋg] /ʔíwang/'sea', [munʔíwwʌŋg] /munʔíwwang/ 'to pass (two objects going in different directions)'.

1.1.9. /ʔ/ vs /ʔʔ/. [páʔɔ^] /páʔo/ 'handle', [pʌ́ʔʔɔ^] /páʔʔo/ 'spoon'; [pʌʔʌnóp] /paʔanúp/ 'allow itself to be hunted', [pʌʔʔʌnóp] /paʔʔanúp/ 'able to hunt.'

[1] Contrast between single consonants and vowels with identical consonant and vowel sequences may be found with all consonants and vowels of Guhang Ifugao.

[2] When [r] occurs word-final except following central and back vocoids it is phonetically syllabic, receiving the syllable stress. No phonetic or phonemic contrast has yet been found between [ɾ] and [ir] or [er] and it is assumed that [ɾ] is to be interpreted phonemically as either /il/ or /el/. [ʔitšúr] /ʔidúl/ 'lightening'; [ʔʌtšɔ^r] /ʔadól/ 'body'; [hápfʌr] /hábal/ 'mountain garden'; [páŋgɾ] /pángel/ 'chin'; [pangŋgɾ] /pángngel/ 'half (of a whole)'; [támɾ] /támel/ 'cheek': [habpfáwɾ] /habbáwel/ 'a kind of bean'.

1.1.10. /i/ vs /e/. [ʔi] /ʔi/ 'class marker', [ʔe] /ʔe/ 'go'; [ʔínʌ] /ʔína/ 'mother', [ʔénʌ] /ʔéna/ 'he goes'; [hitší] /hidí/ 'there', [hitšé] /hidé/ 'that'; [ʔipʌ́ ʔʔi] /ipáʔʔi/ 'break', [ʔipʌ́ʔʔe] /ʔipáʔʔe/ 'hide'; [hʌl̆ɪ̯ŋghíŋgɔ^n] /halinghíngon/ 'a kind of tree', [hʌl̆ɛ>ŋghéŋgʌn] /halenghéngan/'gather twigs for fuel'; [munhúnni] /munhúnni/ 'change direction', [munhúne] /munhúne/ 'play with top'; [ʔítšɔ^] /ʔído/ 'a red bird', [ʔétšʌ] /ʔéda/ 'they go'; [l̆itúŋgɔ^n] /litúngon/ 'twist', [l̆etéŋgʌn] /leténgan/ '(to) water'; [munpfúl̆iʔ] /munbúliʔ/ 'divide into sections (as fruit); [munpfɔ^l̆é] /munbolé/ 'cause itself to become tired,; [munʔal̆í] /munʔalí/ 'call', [munʔol̆é] /munʔolé/ 'do slowly'.

1.1.11. /e/ vs /a/. [mumpépe] /mumpépe/ 'flutter', [mumpápʌ] /mumpápa/ 'signal for silence'; [l̆etl̆étʌn] /letlétan/ 'eat (as a pest)', [lʌtlátʌn] /latlátan/ 'wash infected sore'; [nʌ́ʔl̆ɛ>ŋg] /náʔleng/ 'wither, spoil', [nʌ́ʔlʌŋg] /náʔlang/ infected with intestinal worms'; [hépɛ>ŋg] /hépeng/ 'one centavo', [ʔʌpé>ŋg] /ʔapéng/ 'check', [hʌpáŋg] /hapáng/ 'branch'; [munʔʌkáʔe] /munʔagáʔe/ 'swim', [ʔʌkʔʌkáʔʌ] /ʔagʔagáʔa/ 'you be early'; [húmʌŋg] /húmang/ 'plant used as a charm', [lumɛ́>ŋg] /luméng/ 'small fungus plant'; [ʔinél̆ɛ>ŋg] /ʔinéleng/ 'brass arm bracelet', [gálʌŋg] /gálang/ 'coins'; [ʔúl̆ɛ>ŋg] /ʔúleng/ 'charcoal', [ʔɔ^lʌ́ŋg] /ʔoláng/ 'intestinal worms'.

1.1.12. /e/ vs /ay/ or /ai/.[3] [nʌl̆él̆e] /naléle/ 'gaping open',

[3] The phonemic contrast between /e/ and /ay/ or /e/ and /ai/ may be questioned by the following observations:

(*a*) A common Ifugao reflex of Ilocano [ay] is [e].

Ilocano	Ifugao
[matáy] 'die'	[mʌté] 'die'
[ʔumáy] 'come'	[ʔumé] 'go'
[baláy] 'house'	[pfʌl̆é] 'house'

(*b*) Morphophonemic phonomena changes [e] to [ay].
umé 'go' plus *an* suffix = *umayán* 'place to go'
naté 'dead' plus *an* suffix = *natayán* 'place of dead'

(*c*) The sequence /ay/ or /ai/ rarely occurs in "true" Ifugao words. Of eight words recorded to date containing word-final [ay], six are probable Ilocano borrowings. [mihʌkʌ́y] /mihakáy/ 'ride horse back' (c.f. Ilocano *agsakay* 'ride'); [nʌlʌ́ylʌy] /naláylay/ 'wilted, rotten' (also Ilocano); [kúmpʌy] /kúmpay/ 'sickle' (also Ilocano); [mumpfʌ́ntʌy] /mumbántay/ 'guard' (c.f. Ilocano *agbantay* 'guard'); [lʌ́ŋgtʌy] /langtay/ 'bridge' (also Ilocano); [pfʌ́ypfʌy] /báybay/ 'ocean' (also Ilocano); [ʔíttʌy] /ʔíttay/ 'little (no known Ilocano cognate)'; [nánʌy] /nánay/ 'sore (no known Ilocano cognate).

Though the functional load carried by the e/ay or e/ai contrast is admittedly light, and though a historical study may reveal no phonemic contrast at all in proto-Ifugao, that such a contrast does exist in modern Guhang Ifugao is evident from the date in hand.

[nʌlÁylʌy] /naláylay/ 'wither, rot'; [nʌpfépfe] /nabébe/ 'large breasted', [pfÁypfʌy] /báybay/ 'ocean', [pfʌpfái] /babái/ 'female'; [nʌkẹkẹ́] /nakeké/ 'laughed', [nʌkʌyʌ́n] /nakayán/ 'an exclamation'; [l̆elέɔ^n] /leleón/ 'make wider', [lʌylʌyʌ́h] /laylayáh/ 'lie'; [mʌté] /maté/ 'die', [ʔítt ʌy] /ʔíttay/ 'little'; [ʔímpe] /ʔímpe/ 'let go', [kúmpʌy] /kúmpay/ 'sickle'; [hiné] /hiné/ 'there', [ngʌnne] /ngánne/ 'what, who', [nánʌy] /nánay/ 'skin irritation or sore'; [hʌkét] /hakét/ 'sickness', [hʌláɪt] /haláit/ 'ditch for draining water from eaves'; [l̆élɛ>k] /lélek/ 'deaf', [ʔiláɪ>k] /ʔiláik/ 'squash'; [nʌhé>khɛ>k] /nahékhek/ 'always laughing', [munháik] /munháig/ 'to place prepared rice in jar for fermenting'.

1.1.13. /u/ vs /o/. [ʔítluk] /ʔítlug/ 'egg', [ʔítlɔ^k] /ítlog/ 'kindle'; [ʔitútšu] /ʔitúdu/ 'inject', [itútšɔ^ʔ] /ʔitúdo/ 'write'; [ʔitšúr] /ʔidúl/ 'thunder', [ʔʌtšɔ́^r] /ʔadól/ 'body'; [ʔihúdhud] /ʔihúdhud/ 'report', [ʔih ɔ́^ dh ɔ^ d] /ʔihódhod/ cram, stuff; [mʌlɘ́h] /malúh/ 'pass by', [mʌlɘ́h] /malóh/ 'recede, shrink'; [munʔó^tʔo^t] /munʔútʔut/ 'pain', [munʔɔ́tʔɔt] /munʔótʔot/ 'eat raw'; [munhóphop] /munhúphup/ 'suck', [munhóphɔp] /munhóphop/ 'cover'; [pitúʔ] /pitúʔ/ 'my whistle', [pitɔ́^ʔ] /pitóʔ/ 'soil'; [úluʔ] /ʔúluʔ/ 'my head', [hɔ́^lɔ^ʔ] /hólo?/ 'grass'; [ʔuṇgá] /ʔungá/ 'child', [ʔɔ^ṇgʌ́r] /ʔongál/ 'large'.

1.1.14. /o/vs/a/. [munhóphɔp] /munhóphop/ 'cover', [munhʌ́phʌp] /munháphap/ 'shape, plane'; [ʔitútšɔ^ʔ] /ʔitúdo?/ 'write', [ʔitútšʌ?] /ʔitúda?/ 'lead, guide'; [ʔipʌtɘ́ṇg] /ipatóng] 'mortgage', [ʔipʌtʌ́ṇg] /ʔipatáng/ 'put down'; [tšɘṇglɔ́^nʌ] /donglóna/ 'he hears', [tšɘṇglánʌ] /donglána/ 'head plant'; [ʔɔ^há] /ʔohá/ 'one', [ʔáhʌ] /ʔáha/ 'expression of disfavor'; [pfinʌnɘ́h] /binanóh/ 'borrowed', [pfinánʌh] /binánah/ 'dissolved'; [wʌnɘ́h] /wanóh/ 'g-string', [wánʌh] /wánah/ 'shared meat'.

1.1.15. /o/ vs /aw/ or /au/. [nʌʔʌ́wʔʌw] /naʔáwʔaw/ 'deranged', [nʌʔɔ́^ʔɔ^] /naʔóʔo/ 'remove from container (fowls)'; [nʌʔúlʌw] /naʔúlaw/ 'dizzy', [nʌlɔ́^] /naló/ 'decayed food'; [nʌhʌ́wwʌr] /nahawwal/ 'extra', [nʌhɔ́^ʔwʌr] /nahóʔwal/ 'uproot with instrument'; [munʔinʌ́w] /munʔináw/ 'conceive', [ʔínɔ^] /ʔíno/ 'a term used to draw one's attention'; [l̆ikʌ́um] /ligáum/ 'your basket', [tikɔ́^m] /tigóm/ 'you see'; [káutš] /gáud/ 'spade', [nʌkɔ́^tš] /nagód/ 'cut'; [ʔipáuʔ] /ʔipáuʔ/ 'dip water', [ʔupɔ́^ʔ] /ʔupóʔ/ 'rice bran'.

1.1.16. /i/ vs /ii/. [hákɪt] /hágit/ 'lines on hand', [hʌkíɪt] /hagíit/ 'deer'.

1.1.17. /a/ vs /aa/. [mʌŋgʌ́n] /mangán/ 'eat', [mʌŋgáʌn] /mangáan/ 'remove'.

1.1.18. /u/vs/uu/. [ʔitšúr] /ʔidúl/ lightning', [ʔitšúur] /ʔidúul/ 'give without solicitation'.

1.1.19. Stress Placement. [nʌhílɘŋg] /nahílong/ 'look in awe', [nʌhilɘ́ŋg] /nahilóng/ 'was dark'; [ʔumálĭi] /ʔumáli/ 'come', [ʔumʌlĭí] /ʔumalí/ 'call', [ʔánɔ^n] /ʔánon/ 'remove', [ʔʌnɔ́^n] /ʔanón/ 'eat'.

PHONEME VARIANTS

1.2. When phonemes combine to form syllables and words, various modifications in the phonetic quality of the phonemes may be noted. Such modifications produce phoneme variants or allophones. The major variants are listed below.

1.2.1. [pf], [b]=/b/.[4] The use of the affricate [pf] marks this dialect as distinct from most of the other dialects within the Ifugao linguistic area.

The allophone [pf] occurs except preceding [pf] in an identical consonant cluster. [pfʌĭé] /balé/ 'house'; [ʔípfʌ] /ʔíba/ 'sibling'; [ʔíntipf] /ʔíntib/ 'altar used in pagan ritual'.

The allophone [b] occurs syllable-final preceding [pf] and may occasionally be found as a free variant of [pf] in all other occurrences syllable-final. [ʔíbpfʌ] /ʔíbba/ 'companion'; [ʔiʌ́bpfʌ] /ʔiábba/ 'carry on the back'; [tšibtšíb, tšipftšípf]

[4] The technical names of the phones listed in this paper are as follows:

[pf] Voiceless bilabial affricate
[b] Voiced bilabial stop
[p] Voiceless bilabial stop
[tš] Voiceless dental affricate
[d] Voiced dental stop
[t] Voiceless dental stop
[k] Voiceless velar stop
[g] Voiced velar stop
[ķ] Voiceless back velar stop
[ʔ] Voiceless glottal stop
[#] Partial glottal stricture
[l] Voiced dental lateral
[ĺ] Voiced alveolar lateral flap
[r] Voiced retroflexed palatal vibrant
[m] Voiced bilabial nasal
[n] Voiced dental nasal
[ŋg] Voiced back velar nasal

(*Continued on next page*)

/dibdíb/ 'breeze'; [hɔ^bhɔ^pfʌ́n,hɔ^pfhɔ^pfʌ́n] /hobhobán/ 'extinguish'. It is most often found in loan words such as [tʌ́blʌ,tʌ́pflʌ] /tábla/ 'board'; [l̆íblu,l̆ípflu] /líblu/ 'book'.

1.2.2. [tš] [d] = /d/. Like the allophone [pf], the affricate [tš] also marks the Guhang dialect as distinct from most other Ifugao dialects.

The allophone [tš] occurs except syllable-final preceding [tš]. [tšitšá] /didá/ 'they'; [wátšʌ] /wáda/ 'exists'.

The allophone [d] occurs syllable-final preceding [tš] to form an identical consonant cluster and may be found as a free variant of [tš] syllable-final preceding all other consonants. [numpʌ́dtš͡ʉng] /numpáddung/ 'same'; [pfʌdtšáŋgʌn] /baddángan/ 'help'; [midmʌ́pt͡ɔ^ʔ,mitšmʌ́pt͡ɔ^ʔ] /midmápto?/ 'maybe'; [mʌdl̆ík,mʌtšl̆ík] /madlíg/ 'move'.

1.2.3. [k], [g]=/g/.

The allophone [k] occurs in unrestricted environment. [mʌkʌ́ḥ] /magáh/ 'fall'; [kɔ^kɔ́^tšɔ^n] /gogódon/ 'cut flesh'.

When the phoneme /g/ occurs syllable-final it is usually pronounced with slight voicing to produce the allophone [g]. [ʔʌkké, ʔʌgké] /ʔaggé/ 'didn't'; [ʔítluk, ʔítlug] /ʔítlug/ 'egg'.

1.2.4. [ʔ], [#] = /ʔ/.

The allophone [ʔ] may be found in unrestricted distribution [ʔʌ́rkɔ^] /ʔálgo/ 'day'; [ʔʌd ʔuáni] /ʔad ʔuáni/ 'now'.

The allophone [#], consists of varying degrees of glottal stricture and occurs as a free variant of glottal stop in intervocalic position, especially in rapid speech. [pfɔ^ʔɔ́^n,pfɔ^-

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[h] Voiceless glottal fricative
[ḥ] Voiceless pharyngeal fricative
[s] Voiceless alveolar sibilant
[w] Voiced labial semi-vowel
[y] Voiced palatal semi-vowel
[i] Voiced high, close, front, unrounded vocoid
[ɪ] Voiced high, open, front, unrounded vocoid
[ɪ˃] Voiced high, open, front, backed, unrounded vocoid
[e] Voiced mid, open, front, unrounded vocoid
[ɛ] Voiced mid, open, front, unrounded vocoid
[ɛ˃] Voiced mid, open, front, backed, unrounded vocoid
[ʌ] Voiced mid, open, central, unrounded vocoid
[a] Voiced low, open, central, unrounded vocoid
[u] Voiced high, close, back, rounded vocoid
[ʊ] Voiced high, open, back, rounded voocid
[ʉ̟] Voiced high, open, back, rounded pharyngealized vocoid
[o^] Voiced mid, close, raised, back, rounded voocid
[o] Voiced mid, close, back, rounded vocoid
[ɔ^] Voiced mid, open, back, rounded vocoid
[ɔ] Voiced low, close, back, rounded vocoid
[ɔ̟] Voiced low, close, back, rounded pharyngealized vocoid

#ɔ^n] /boʔón/ 'not'; [lʌlάʔi,lʌlá#i] /lalάʔi/ 'male'.

1.2.5. [l], [ɺ], [r] = /l/. The phoneme /l/ has three allophones which occur as follows:

The allophone [l] occurs syllable-initial followed by central and back vowels /a/, /u/, and /o/. [pfálʌt] /bálat/ 'banana'; [lumáhu] / lumáhu/ 'hot'; [lɔ^ʔtʌtš] /lóʔtad 'later'. It occurs syllable-final followed by [l] (i.e. as the first member of an identical consonant cluster). [tšumάllʌn] /dumállan/ 'walk'; [ʔʌllάn] /ʔallán/ 'giant, monster'.

[ɺ] is a lateral flap produced by the forward flap of the tongue tip past the alveolar ridge. It occurs syllable-initial preceding front vocoids /i/ and /e/. [ɺétɛ>ŋg] /léteng/ 'water'; [pfʌɺé] /balé/ 'house'.

The allophone [r] occurs syllable-final except preceding [l]. [ʔάrkɔ^] /ʔálgo/ 'sun'; [ʔʌtšɔ^r] /ʔadól/ 'body'; [ʔɔ^ŋgάr] /ʔongál/ 'big'; [páŋgr] /pángel/ 'chin'.

1.2.6. [h], [ḥ], [s] = /h/.

The allophone [ḥ] (a pharyngeal fricative produced by the approximation of the tongue root to the pharynx wall) occurs after central and back vowels /a/, /u/, and /o/ and the allophone [s] occurs after front vowels /i/ and /e/, in the following positions:

[a] Word-final. [mʌlʉḥ] /malúh/ 'pass by'; [márpʌḥ] /málpah/ 'will finish'; [mɪ˙ḳɔ^dlis] /mikódlih/ 'slide'; [hʌʔʔís] /haʔʔíh/ 'ten centavos'.

[b] Syllable-final in the penult when that syllable is reduplicated in the ultima. [mʊntšάḥtšʌḥ] /mundáhdah/ 'peel bark'; [mʊnwάḥwʌḥ] /munwáhwah/ 'wash, rinse'; [nʌpíspis] /napíhpih/ 'pressed, crushed'; [mʊntšístšis] /mundíhdih/ 'call [dog]'.

[c] Syllable-final in the penult when the ultima is an open syllable.[5] [ʔunάḥmu] /ʔunáhmu/ 'your sugar cane'; [pfinʌnɘ́ḥtšʌ] /binanóhda/ 'they borrowed'; [ʔimisná] /ʔimihná/ 'his smile'; [ʔʌmísʔu] /ʔamíhʔu/ 'my defeat'.

[h] occurs except in the environment of the other two allophones. [hápfʌr] /hábal/ 'mountain garden'; [pɔ^htšɔ^n] /pohdón/ 'want'.

The occurrence of the allophone [s] is rare in this dialect.

[5] [ḥ] has been observed in this environment only when followed by the personal pronoun suffixes, which as yet have not definitely been proven to be phonologically attached to the word base. This problem will be discussed in a subsequent paper.

Of the words found containing [s], many are borrowed from other languages. Some of these borrowings appear to have modified the distribution pattern of this alternant. For example, [pfístulu] /bíhtulu/ "teacher' (from Spanish *maestro*) and [mʊn?isḳɔ^r] /mun?ihkól/ 'study' (from English *school*) contain [s] in environments other than those stated in the distribution statement above. Another apparent exception to the stated distribution of [s] above occurs when [mɪ˃ḳɔ^dlis] /mikódlih/ 'slide', takes the personal pronoun suffix *a?* to become [mɪ˃ḳɔ^dlísʌ?] /mikodlíha?/ 'I slide' in which [s] occurs syllable-initial in the ultima.

1.2.7. [i], [ɪ], [ɪ˃] = /i/. The phoneme /i/ consists of three allophones which occurs in the following positions:

The allophone [ɪ] occurs in closed syllables preceding /p/ and /t/. [mʊnhíhɪp] /munhíhip/ 'suck (Juice from fruit, etc.)'; [tɪptɪppá?ɔ^n] /tiptippá?on/ 'slap, hit'; [?ɪt?ɪttʌŋg] /?it?ít-tang/ 'small'.

The allophone [ɪ˃] occurs in closed syllables preceding back velars. [?ɪ˃ḳtɔ^n] /?íkton/ 'knit'; [mi?ɪ˃ḳtʌd] /mi?íktad/ 'attend fiesta'; [l̆ɪ˃ŋgŋgi] /língngi/ 'a food made from beans'. This allophone may be found in open unstressed syllables preceding back velars in rapid speech. [l̆ɪ˃ŋgʊ́ḥ] /lingúh/ 'cut down'.

The allophone [i] occurs elsewhere. [?inʌ́n] /?inán/ 'ate'; [mʌtíkɔ^] /matígo/ 'can be seen'; [hʌpfál̆i] /habáli/ 'another'.

1.2.8 [e], [ɛ], [ɛ˃] = /e/. There are three allophones of the phoneme /e/ which occur in various positions within the syllable.

The allophone [ɛ] occurs in closed syllables preceding /p/ and /t/. [nʌpepɛ́p] /napepép/ 'talkative'; [l̆ɛ́ɛp] /léep/ 'sunflower';[l̆ɛtl̆étʌn] /letlétan/ 'eat (as a pest)'.

The allophone [ɛ˃] occurs in closed syllables followed by syllable-final back velars. [ŋgéŋgɛ˃ḳ] /ngéngek/ 'black'; [pɛ˃ḳpéḳɔ^n] /pekpékon/ 'shape, form'. This allophone may be observed in open syllables preceding back velars in rapid speech. Thus the two examples above may be pronounced [ŋgé˃ŋgɛ˃ḳ] and [pɛ˃ḳpé˃ḳɔ^n].

The allophone [e] occurs elsewhere. [?étʌ] /?éta/ 'let us [dual] go'; [pfʌl̆é] /balé/ 'house'.

1.2.9. [a], [ʌ] = /a/. There are two allophones of the phoneme /a/.

The allophone [a] occurs in open stressed syllables. [ʔámʌ] /ʔáma/ 'father'; [hákʌd] /hágad/ 'broom'; [mɔ^má] /momá/ 'areca palm'.

The allophone [ʌ] occurs in closed syllables and in open unstressed syllables. [ʔʌ́mpo^t] /ʔámput/ 'garlic'; [kʌ́ntšɔ^] /gándo/ 'rat'.

1.2.10. [u], [ʊ], [ʊ̯], [o^], [o] = /u/. There are five major allophones of the phoneme /u/ produced by the occurrence of this phoneme in various positions within the syllable and contiguous to various other phonemes.

The allophone [ʊ] occurs in closed syllables preceding syllable-final /d/ and /n/. [ʔitulʊ́d] /ʔitulúd/ 'accompany and return'; [ʔihʊ́dhʊd] /ʔihúdhud/ 'report, tell'; [mʊnmɔ^má] /munmomá/ 'chew areca palm nut'.

The allophone [ʊ̯], (a pharyngealized vocoid) occures in closed syllables preceding back velars and [ḫ]. It is pronounced with pharyngealization, of varying degrees, most noticeably with [ḫ]. [hálʊ̯ŋg] /hálung/ 'hole in bolo handle'; [ʔʊ̯́kḳɔ^n] /ʔúkkon/ 'pup'; [mʊnlikkʊ̯́ḫ] /munliggúh/ 'turn the head'.

The allophone [o^] occurs in closed syllables preceding /t/. [híʔko^t] /hígut/ 'knot'; [ʔihʌ́ʔʔo^t] /ʔiháʔʔut/ 'deny'.

The allophone [o] ocurs in closed syllables followed by syllable-final /p/. [humíkop] /humígup/ 'enter'; [ʔopʔóp] /ʔupʔúp/ 'skin'; [mʊnʔʌnóp] /munʔanúp/ 'hunt'.

The allophone [u] occurs except in the environments of the other four allophones listed above. [ho^thútɔ^n] /huthúton/ 'tighten'; [ʔúŋgʌ] /ʔúnga/ 'child'; [ʔúlu] /ʔúlu/ 'head'.

1.2.11. [ɔ^], [ɔ], [ɘ] = /o/. There are three allophones of the phoneme /o/ produced as follows:

The allophone [ɔ] occurs when the phoneme is found in closed syllables preceding /p/ or /t/ [ʔinɔ́p] /ʔinóp/ 'dream'; [híḳɔt] /híkot/ 'a kind of bird'.

The allophone [ɘ̯] (a pharyngealized vocoid) occurs when the phoneme is found in closed syllables preceding back velars and [ḫ]. The pharyngealization is of varying degrees but is most noticeable with [ḫ]. [ʔɘŋgʔɘ́ŋgŋgʌr] /ʔongʔóngngal/ 'very big'; [mʊnḳɘ́ḳḳɘḳ] /munkókkok/ 'to cluck (as mother hen)'; [ʔipɘ́ḫpɘḫ] /ʔipóhpoh/ 'hold'.

The allophone [ɔ^] occurs except in the stated distribution of the other two allophones. [mʌphɔ́^d] /maphód/ 'good'; [ʔɔ^mpánʌ] /ʔompána/ 'below'; [nɔ^mnɔ^mɔ́^n] /nomnomón/ 'remember'.

1.2.12. Stress.

Primary stress, ['], occurs on either the penult or ultima and is not predictable in terms of any other phonological feature. [ʔámʌ] /ʔáma/ 'father'; [núʌŋg] /núang/ 'carabao'; [pfʌlé] /balé/ 'house'; [ʔumé] /ʔumé 'go.'

Secondary stress [`] is predictable in terms of primary stress. When primary stress falls on the ultima, secondary stress is found on the antepenult of polysyllabic words. [hìnʌmʌ́r] /hinamál/ 'cooked rice'; [ʔìtulúd] /ʔitulúd/ 'accompany and return'; [hʌ̀kʌtšʔú] /hagadʔú/ 'my broom'; [ʔʌ̀witɔ^n] /ʔawitón/ 'get (a person)'.

1.3. Evidence of allophone grouping.

It is not possible to demonstrate the function of the allophones of /i/, /e/, /u/, and /o/ on the basis of complementary distribution alone since the distribution of the allophones [i], [ɪ], and [ɪ˃] exactly parallels that of the allophones [e], [ɛ], and [ɛ˃] respectively, and the parallel in distribution of the allophones of the phonemes /u/ and /o/ is sufficiently similar to cause the same problem in allophone grouping. Because of this situation, the allophone [i], for example, is found to be in complementary distribution not only with [ɪ] and [ɪ˃] (which were listed above as member allophones of the same phoneme) but with [ɛ] and [ɛ˃] as well.

The following is suggested as further evidence for uniting the allophones in question as indicated above:

1.3.1. Modification of syllable pattern.

The allophones [i], [e], [u], and [ɔ^] occur in open syllables. All other allophones in question occur in closed syllables. When a VC pattern suffix is added to a word ending in closed syllables of either a VC or CVC pattern, these syllables become V and CV respectively, forming open syllables, and the consonant which closed them functions as the initial consonant of the CVC syllable pattern which is thus formed. When a closed syllable containing one of the allophones in question becomes open, but the morpheme in which it is found remains unchanged, its member allophone which functions in open syllables replaces it. Thus each allophone found in closed syllables is identified with one of the four allophones found in open syllables. These replacements are alleged to be between allophones of the same phoneme and not morphophonemic replacements of different phonemes. Although in each example of those listed below the replacement occurs at morpheme boundaries, the function of the

phones in question is not determined by morphological features, but by phonological structuring since they may be found to function as indicated below in all such phonological environments regardless of morpheme boundaries.

The following changes have been observed:

Allophone substitutions	First environment	Modifications	Second environment
[ɪ]>[i][6]	[mʊn.há.pɪt] 'speak'	+[ʌʔ]	[mʊn.há.pi.tʌʔ] 'I speak'
	[mʊn.hí.hɪp] 'suck'	[ɔ^n]R[mʊn][7]	[hi.hí.pɔ^n] 'suck'
[ɪ>]>[i]	[mʊn.lá.ɪ>k] 'squash'	+[ʌʔ]	[mʊn.lá.ik.ʌʔ]'I squash'
	[mʊn.ḳidʔ(>ng] 'wink'	[ɔ^n]R[mʊn]	[ḳid.ʔí.ŋgɔ^n] 'wink'
[ɛ]>[e]	[mʌh.ʔét] 'hurts'	+[ɔ^n]	[mʌh.ʔe.tɔ́^n] 'feel pain'
[ɛ>]>[e]	[nʌḳe.ḳé>k] 'always laughing'	+[ʌʔ]	[nʌ.ḳe.ḳé.ḳʌʔ] 'I am always laughing'
	[ʔu.mé.tɛ>ng] 'pinch'	[ɔ^n]R[um]	[ʔe.té.ŋgɔ^n] 'pinch'
[ʊ]>[u]	[hu.muʔ.tšútš] 'kick'	[ɔ^n]R[um]	[huʔ.tšú.tšɔ^n] 'kick'
	[lu.má.hʊn] 'marry'	+[ɔ^n]	[lu.mʌhú.nɔ^n] 'place to marry'
[ʉ]>[u]	[mʉŋ.ḳu.hí.ḳʉḥ] 'crumple'	[ɔ^n]R[mʉŋ]	[ḳu.hi.ḳú.hɔ^n] 'crumple'
	[mum.pfú.ʉŋ] 'wear necklace'	+[ʌʔ]	[mum.pfu.u.ŋgʌʔ] I' will wear a necklace
[o^]<[u]	[mum.pfʌ́ʔ.no^t] 'pull up plants by roots'	[ɔ^n]R[mum]	[pfʌʔ.nú.tɔ^n] 'pull up plants by roots'
	[hu.mó^t.ho^t] 'tighten'	[ɔ^n]R[um]	[ho^t.hú.tɔ^n] 'tighten'
[o]>[u]	[hu.mí.kop] 'enter'	[ɔ^n]R[um]	[hi.kú.pɔ^n] 'enter'
	[mʊn.hóp.hop] 'suck'	[ɔ^n]R[mʊn]	[hop.hú.pɔ^n] 'suck'
[ɔ]>[ɔ^]	[mʊn.tšɔ́^.pɔp] 'catch'	[ɔ^n]R[mʊn]	[tšɔ^.pɔ́^.pɔ^n] 'catch'
	[hu.mɔ́p.hɔp] 'cover'	+[ʌʔ]	[hu.mɔp.hɔ́^.pʌʔ] 'I cover'
[ə]>[ɔ^]	[mʉŋ.kə́ḥ.kəḥ] 'cut into pieces'	[ɔ^n]R[mʉŋ]	[kəh.kɔ^.hɔ́^n] 'cut into pieces'
	[mʊn.nʌ.nə́ŋ] 'remain'	+[ʌʔ]	[mʊn.nʌ.nɔ́^.ŋgʌʔ] 'I remain'

1.3.2. Native reaction.

Native reaction is suggested as a further indication of the

[6] Read [ɪ] becomes [i]
[7] Read [ɔ^n] replaces [mʊn]

phonemic status of the questionable allophones. Below are listed words taken from text material in which the allophones of /i/, /e/, /u/, and /o/ occur with the spelling of each as written by the informant mentioned in the introduction to this paper. The informant has been taught a few orthographical changes from a strictly phonemic spelling such as the omission of word-initial glottal stop, the omission of stress (except when stress placement is the minimal difference between two lexically different words), etc. No attempt, however, has been made to teach the informant the spelling of any given word. The spelling below represents her own reaction to the words dictated.

Written phonetically	Written phonemically	As written by informant
[hitší]	/hidí/	hidi 'there (far)'
[limá]	/limá/	lima 'five'
[tinníkɔ^]	/tinnígo/	tinnigo 'saw'
[ŋgíl̆ik]	/ngílig/	ngilig 'yard'
[munhí˃kk̟ɛ˃ŋg]	/munhíkkeng/	munhikkeng 'a game'
[ʔí˃ŋgŋgi]	/ʔíngngi/	ingngi 'baby girl'
[ʔʌkké]	/ʔaggé/	agge 'not'
[létɛ˃ŋg]	/léteng/	leteng 'water'
[héɛp]	/héep/	heep 'sunflower'
[mʌhk̟ét]	/mahkét/	mahket 'painful'
[nʌrtéŋgʌn]	/nalténgan/	naltengan 'drown'
[pɛ˃k̟pék̟ɔ^n]	/pekpékon/	pekpekon 'shape, form'
[lumáhu]	/lumáhu/	lumahu 'hot'
[pfútšu]	/búdu/	budu 'hairlike thorns'
[ʔitulúd]	/ʔitulúd/	itulud 'accompany and return'
[nʊnhíklʌ]	/nunhígla/	nunhigla 'intensify'
[nʌpʊ̟́h̟]	/napúh/	napuh 'consumed'
[hálʊ̟ŋg]	/hálung/	halung 'hole in bolo handle'
[mʊnʔukót]	/munʔugút/	mun-ugut 'sew'
[pfumáho^t]	/bumáhut/	bumahut 'presage'
[ʔopʔóp]	/ʔupʔúp/	up-up 'skin'
[ʔuhóp]	/ʔuhúp/	uhup 'late, long time'
[pɔ^htšɔ́^n]	/pohdón/	pohdon 'want'
[ʔɔ^nɔ́^m]	/ʔonóm/	onom 'six'
[hik̟ɔt]	/híkot/	hikot 'kind of bird'
[mʊnhɔ́phɔp]	/munhophop/	munhophop 'cover'
[nʌlɔ́h̟]	/nalóh/	naloh 'shrink, recede'
[hálə̟ŋg]	/hálong/	halong 'pitch pine'

1.3.3. Phonetic similarity.

The allophones [ɛ] and [ɛ˃] are more phonetically similar to [e] than to [i], [ɪ], or [ɪ˃] and the allophones [ɔ] and [ə̟] are more phonetically similar to [ɔ^] than to [u], [ʊ], [ʊ̟], [o^], or [o].

The data listed above suggests that [i], [ɪ], and [ɪˀ] are submembers of the same phoneme, that [e], [ɛ], and [ɛˀ] are submemebers of the same phoneme, that [u], [ʊ], [ʉ], [oˆ], and [o] are submembers of the same phoneme and that [ɔˆ], [ɔ], and [ə] are submembers of the same phoneme.

THE SYLLABLE

2.1. Syllable division.

A syllable is here defined as a phonological unit consisting of one syllabic or syllable peak which receives syllable stress,[8] is one mora in length, and which may be preceded and/or followed by a nonsyllabic which functions as a marginal on or off glide to the peak of the syllable. All consonant phonemes may open or close the syllable and precede or follow any vowel with the exception of /y/ which has not been observed following front vowels, and /w/ which has not been observed following back vowels.

2.2. Syllable structure.

There are four types of syllables formed by the following combinations of vowels and consonants.

2.2.1. *CV.* A syllable may consist of a consonant functioning as the syllable margin followed by a vowel functioning as the syllabic or syllable nucleus. lu.má.hu/ 'hot'; /ʔu.mé/ 'go'; /la.lú/ 'pestle'.

2.2.2. *CVC.* The vowel may be both preceded and followed by a consonant in forming a more complex syllable. /mun.báng. ngad/ 'return'; /gád.deng/ 'goat'; /nán/ 'a grammatical class marker'.

2.2.3. *VC.* A vowel followed by a consonant may function to form a syllable. /ʔi.áb.baʔ/ 'I will carry (on back)'; /bú.ung/ 'an Ifugao necklace'; /ma.ngá.an/ 'remove'.

2.2.4. *V.* A vowel may function alone to form the most simple type of syllable. /ma.ga.á.tan/ 'clean (by cutting)'; /ba.bá.i/ 'female'.

THE WORD

A word may be defined as from one to six syllables functioning as a phonological unit, containing a single primary stress, with the addition of predictable secondary stress in polysyllabic words. (See Sec. 1.2.12). No restrictions of phoneme combina-

[8] This is to be distinguished from word stress as mentioned in section 1.2.12.

tions seem to exist within the word and it appears theoretically possible for all combinations to occur.

3.1. Word patterns. Any combination of syllable patterns may combine to form a word with the following exceptions:

(*a*) Syllable patterns VC and V may not occur word-initially. All words begin with consonants.

(*b*) Syllable patterns CVC or VC may not be followed contiguously by VC or V. When a consonant is contiguously followed by a vowel, it always functions as a nonsyllabic on-glide to the vowel.

(*c*) Two syllables of the pattern V are not found contiguous to each other.

3.1.1. Interpretation of high vocoids.

The high vocoids [i] and [u] have a dual function since they may be found as syllabics or as nonsyllabics within the syllable. When they function as syllabics receiving the peak of the syllable stress, they are interpreted as vowels [i] and [u], and when they function as nonsyllabic marginal on or off-glides to the syllable, they are interpreted as /y/ and /w/.

The following interpretations of high front and back vocoids are necessary to conform to the phonemic syllable and word patterns of this dialect.

(*a*) When they occur word-initial, they are interpreted as consonants to conform to the nonsuspect word pattern, in which no vowel may occur word-initial. [iʌkuiá] /yaguyá/ 'why'; [uátšʌ] /wáda/ 'there is'.

(*b*) When they occur in intervocalic position they are interpreted as consonants to conform to the nonsuspect word patterns which do not allow a three vowel cluster. [ʔʌdtšáiʌ] /ʔaddáya/ 'sky'; [nʌlʌuá] /nalawá/ 'bad'.

(*c*) When they occur word-final following a consonant, they are interpreted as vowels /i/ or /u/ since consonant clusters are not found within the syllable. [hitší] /hidí/ 'there (far)'; [ḳáhu] /káhu/ 'dog'.

3.1.2. Consonant clusters.

When syllable patterns CVC or VC are followed by the patterns CV or CVC within the word, consonant clusters of two consonants result. The following clusters have been observed:

bb, bd, bg, bh, bk, bl, bn, bng, bt, by, bʔ; db, dd, dg, dh, dl, dm, dn, dp, dʔ; gb, gd, gg, gh, gl, gm, gn, gp, gt, gw, gy, gʔ; hb, hd, hg, hh, hk, hl, hm, hn, hp, ht, hw, hy, hʔ; kd, kh, kk, kp, kt, kw; lb, ld, lg, lh, lk, ll, lm, lng, lp, lt, lw, lʔ; mb, md, mg, mh, ml, mm, mn, mp, mt, mʔ; nb, nd,

nh, nk, nl, nm, nn, ŋng, np, nt, nw, ny, nʔ; pd, pg, ph, pk, pl, pm, pn, pp, pt, pʔ; tb, td, th, tk, tl, tm, tng, tt, tw, tʔ; wg, wk, wm, wt, ww; yb, yg, yl, ym, yn, yt, yy, yʔ; ngb, ngd, ngg, ngh, ngk, ngl, ngn, ngng, ngp, ngw, ngʔ; ʔb, ʔd, ʔg, ʔl, ʔn, ʔt, ʔy, ʔʔ. /ʔíbba/ 'companion', /díbdib/ 'wind', /ʔigóbgob/ 'whet', /habhábung/ 'flower', /kóbkob/ 'skin disease', /búble/ 'country, place', /nabnabhúg/ 'is satisfied', /ŋgabngában/ 'eat', /tábtab/ 'coconut shell used for drinking', /yabyaban/ 'fan a flame', /ʔibʔáh/ 'throw away'; /budbúddeng/ 'rice eating bird', /numpáddung/ 'the same as', /gúdgud/ 'skin disease', /munhúdhud/ 'relate', /madlíg/ 'move', /midmápto?/ 'maybe', /nádne/ 'long ago', /ʔipódpod/ 'cram', /ʔadʔuáni/ 'today, now'; /ʔipágbod/ 'throw away', /nagdohán/ 'worn path', /tigtiggón/ 'looking at', /ʔibughól/ 'open', /ʔinatogláb/ 'open (door); /logmón/ 'act recklessly', /ʔogʔógnan/ 'carrying', /palágpag/ 'breast', /tinagtággu/ 'doll', /wógwog/ 'malaria', /munyágyag/ 'shake', /ʔagʔagá/ 'early'; /ʔuhbúngon/ 'put inside', /pohdón/ 'want', /munggóhgoh/ 'cut into pieces', /ʔohʔohhá/ 'only one', /mahkét/ 'painful', /ʔihló?/ 'use grass as medicine', /mihmoʔán/ 'pitiful', /mahnán/ 'rush', /máhpe/ 'expression', /munditáhtah/ 'stamp foot', /munwáhwah/ 'wash, rinse', /yáhyah/ 'breath', /lumáhʔon/ 'get down'; /dakdakkól/ 'many', /hukhúkon/ 'call pigs', /munbákka/ 'crawl', /pekpékon/ 'shape, form', /miʔíktad/ 'attend fiesta', /wákwak/ 'call of crow'; /nálbong/ 'flooded', póldon/ 'divide', /ʔálgo/ 'sun, day', /bólhon/ 'borrow', /munkólkol/ 'call chickens', /bulláki/ 'handsome', /dinálman/ 'a kind of rice jar', /mingólngol/ 'become dull', /nálpah/ 'finish', /nabóltan/ 'inherited', /wólwol/ 'molar teeth', /ʔolʔolláyon/ 'go slowly'; /ʔimablé/ 'child', /ʔidámdam/ roast or put near fire', /húmgop/ 'enter', /pinumhód/ 'successful', /pámloh/ 'buy (house, forest, etc.); /ʔimmé/ 'went', /nomnomón/ 'think', /himpúlu/ 'ten', /ʔinumtingán/ 'quiet', /ʔamʔamá/ 'old man'; munbángngad/ 'return', /ʔindát/ 'gave', /nunhabí/ 'pregnant', /munkókkok/ 'cluck (as mother hen)', /nánloʔ/ 'grass used as medicine', /munmomá/ 'chew betel nut', /ngánne/ 'what', /pinngítna/ 'edge', /munpalénha/ 'iron', /muntámu/ 'work', /ʔinwáhna/ 'two days after tomorrow', /ʔinyé/ 'took', /munʔanúp/ 'hunt'; /mundapdapá/ 'feeling the way', /hápgid/ 'sideburn', /munhúphup/ 'is sucking', /mungkupkuppín/ 'is folding', /naplód/ 'cut into pieces', /mapmaphód/ 'very good', /lápne/ 'camote', /happîtan/ 'speech', /lumáptuʔ/ 'jump', /ʔupʔúp/ 'skin'; /munbotbóttoʔ 'is harvesting', /mundatdáttong/ 'is seeking', /huthúton/ 'tighten', /kitkíttang/ 'small', /ʔátlu/ 'third', /munmamayútmut/ 'wiggle nose as a rat', /dinatngán/ 'overtake', /ʔatʔattón/ 'doing', /nawótwot/ 'poor', /munʔótʔot/ 'eat something raw'; /munggawgawwát/ 'is borrowing', /mikawkawwín/ 'desire to accompany', /mawmawíit/ 'early in the morning', /tawtawwáng/ 'small net for catching birds, etc.', /nahawwál/ 'remainder'; /báybay/ 'ocean', /mungguyguyyúd/ 'is pulling', /laylayyáh/ 'lie', /maymayyápit/ 'very thin', /taynán/ 'leave behind', /muntaytayyápan/ 'is flying', /gayyúm/ 'friend', /munʔayʔayyám/ 'is playing', /bungbungáan/ 'fruit tree', /ʔidángdang/ 'dry near the fire', /punggayáng/ 'strike', /ʔipénghan/ 'repeat', /langkák/ 'tie', /dónglon/ 'hear', /túngnin/ 'cold', /mángngol/ 'one who hears or listens', /ʔipangpangúlu/ 'go ahead', /bangwáhon/ 'divide', /ʔungʔúnga/ 'small child'; /ʔiháʔba/ 'place', /hóʔdod/ 'short', /híʔgut/ 'knot', /ʔiháʔlit/ 'interrupt in falling', /baʔnúton/ 'pull up by roots', /lóʔtad/ 'later', /piʔyayyám/ 'playmate', /ʔuʔʔúnga/ 'children'.

3.1.3. Vowel clusters.

When the syllable pattern CV is followed by pattern VC or V or when the pattern V is followed by the pattern VC within the word, vowel clusters are formed. Such clusters have been observed in the following combinations: *ii, ie, ia; ee, ea; ai, aa; ua, uu, uo*; *oa*. /mawíit/ 'tomorrow', /ʔiém/ 'you take', /ʔiálim/ 'bring'; /héep/ 'sunflower', /ʔaggéaʔ/ 'I did not'; /haítan/ 'whet stone', /ʔaalíwan/ 'forget'; /ʔadʔuáni/ 'today', /ʔanúud/ 'when', /bumanúot/ 'smolder'; /manigoáʔ/ 'I'm looking for'.

3.2. Transition.

Open transition, occurring as a nonphonemic vocoid, is found between syllable-final velar, back velar and glottal stops and initial /h/ of the following syllable, and between syllable-final /h/ and initial glottal stop of the following syllable. The vocoid interrupting these consonant clusters is an echo vowel taking the quality of the vowel of the preceding syllable. [lɔ̂kʰhɔ̂n] /lóghon/ 'slice', [l̆impʌ́ḥʰʔu] /limpáhʔu/ 'I finished'.

An audible nonphonemic vocoid glide occurs between front vowels and back velar consonants as follows:

(*a*) A vocoid glide is present when front vocoids either precede or follow [ḳ], [miʔi̯ʲʰḳtatš] /miʔíktad/ 'attend fiesta', [ḳʰinuhiʰḳɯ̯ḥʰʔu] /kinuhikúhʔu/ 'I crumpled', [ḳʰeḳʰé] /keké/ 'laughter'.

(*b*) A vocoid glide is present when front vocoids precede [ṇg]. [hiʰṇgítɔ̂n] /hingíton/ 'look for'.

4. ILLUSTRATIVE TEST (written phonemically)

NGUPNGUPPUH ʔI AʔALUTTON
Ngupnguppúh and Aʔalútton

1. Wáda da Ngupnguppúh ʔi Aʔalútton. 2. ʔohán ʔálgo ʔimmé hi
Is they Ngupnguppúh and Aʔalútton. One day went

Ngupnguppúh hi balén Aʔalútton. 3. ʔayyóna ʔi hiá ʔéta muntanóm hi
Ngupnguppúh house Aʔalútton. Says-he him go-we plant

bálat. 4. ʔayyón Aʔalútton hi ʔo ʔot ʔimméda. 5. Dinnatóngda
banana-plant. Says Aʔalútton yes and went-they Found-they

han ʔunʔohá ʔan bálat. 6. Binangwáhda ʔot ʔalán Ngupnguppúh
an only-one banana-plant. Divided-they and got Ngupnguppúh

nan natubúan ya hi Aʔalútton hinán wáday lamútna. 7. ʔintanómda
the leaf-half and Aʔalútton there is root-half-his. Planted-they

ʔan duá. 8. Nalúh di duán ʔalgo ʔida tinnígo nan ʔintanómda ya
two. After the two day go-they saw the planted-they and

naté di ʔintanóm Ngupnguppúh. 9. Hánan ʔintanóm Aʔalútton ya
dead the planted Ngupnguppúh. planted Aʔalútton
bimmúnga. 10. ʔumámoh hi Ngupnguppúh. 11. ʔayáton Aʔalútton
was-bearing-fruit. Jealous Ngupnguppúh Climb Aʔalútton
nan balátna ya ʔadí paʔʔáyat. 12. ʔináyat Ngupnguppúh
the banana-plant-his and not able-to-climb. Climbed Ngupnguppúh
ʔot punʔaʔána nan nalúm ʔan bálat. 13. ʔayyón Aʔalútton ʔipáʔbon
and eat-he the ripe bananas. Says Aʔalútton drop-you
ʔah ʔanóʔ. 14. ʔimpaʔbón Ngupnguppúh ya ʔabúh nan ʔukáʔ nan bálat.
eat-I. Dropped Ngupnguppúh and only the skin the banana.
15. Bimmúngot hi Aʔalútton ʔot ʔimmé numbítu. 16. ʔinayaganá hi
Angry Aʔalútton and went dug-hole. Called-he
Ngupnguppúh. 17. ʔimbíʔah Ngupnguppúh ya nabitúan. 18. ʔayyón
Ngupnguppúh. Ran Ngupnguppúh and entered-hole. Says
Aʔalútton ʔiálim ʔah ʔanóʔ hinán bálat te ʔadím ʔidát ya
Aʔalútton give-you eat-I of-the banana because not-you will-give and
patayón daʔá. 19. Maʔʔíd ʔah ʔindat Ngupnguppúh ʔot doʔmáyan
will-kill you-(I). None gave Ngupnguppúh and throw
Aʔalútton hi bátu ʔot hidéwe di lúbuʔ Ngupnguppúh.
Aʔalútton stone and that the grave Ngupnguppúh.

FREE TRANSLATION

1. There were Ngupnguppúh and Aʔalútton. *2.* One day Ngupnguppúh went to the house of Aʔalútton. *3.* He said to him, let's go and plant a banana plant. *4.* Aʔalútton said yes, and they went. *5.* They found only one banana plant. *6.* They divided it and Ngupnguppúh got the leaf half and Aʔalútton had the root half. *7.* The two of them planted. *8.* After two days they went to see what they had planted and what Ngupnguppúh planted was dead. *9.* That which Aʔalútton had planted was bearing fruit. *10.* Ngupnguppúh was jealous. *11.* Aʔalútton (tried to) climb his banana plant but could not climb. *12.* Ngupnguppúh climbed and ate the ripened bananas. *13.* Aʔ alútton said, you drop me some to eat. *14.* Ngupnguppúh dropped some but it was only the banana skin. 15. Aʔalútton was angry and went to dig a hole. *16.* He called Ngupnguppúh. *17.* Ngupnguppúh went and fell into the hole. *18.* Aʔalútton said, you give me a banana to eat because if you will not give it I will kill you. *19.* Ngupnguppúh would not give any and Aʔalútton threw a stone and that was the grave of Ngupnguppúh.

BOOK

Books received from time to time by the Philippine Journal of Science are reviewed and acknowledged in this section.

Principles of Fungicidal Action. By James G. Horsfall. Waltham, Mass., Chronica Botanica Co.; Manila, Philippine Education Co. Inc., 1956. Price, $6.50

This new book, which forms Volume 30 of the "New Series of Plant Science Books" of the Chronica Botanica, blazes a guide trail through a tangled forest of information on the principles of fungicidal action. For the proper understanding of the solutions to many of the practical problems related to the control of fungus diseases of plants, a more necessary book could not have been written. Consisting of 15 chapters it is intrinsically a resume of all available information on the mechanism of fungitoxicity outside and inside the fungus cell.

The book opens with a brief account of important events of fungicide history followed by a discussion of the chemical protection of the host from fungal attack and a description of the physical and chemical reactions involved in a protection as well as the technique of fungitoxicity which supports a successful protection. Elsewhere in the text author tries hard to untangle the intricately complex subject of permeation of toxicants into the fungus cell and goes far in attempting in many sections to distinguish toxicity.

He also tries hard to portray the phenomena associated with physical toxicity, chelation and antimetabolites, and to harmonize the various views of different investigators regarding their role in the mechanism of fungitoxicity.

Of great interest to plant pathologists is the chapter on the dithiocarbamate compounds of which some are described to have a broad spectrum of disease control. Many new compounds are also discussed in the chapters dealing with quinones and heterocyclic compounds which may give local researchers interesting leads in their search after fungicides for use in controlling fungus diseases of local crops.

The book concludes with a chapter on chemotherapy, a subject described by its author as "an exciting new frontier in

plant pathology," which offers a likely solution to the problem of controlling viruses, vasculars and root rots, plant diseases difficult to control by other means.

The vastness of the author's sources of information is shown by the numerous reference citations in the text and the extensive bibliography appended to it which includes a long list of articles authored or co-authored by him. The book as a whole is a valuable contribution to the series of plant science literature.—M. A. P.

ERRATA

VOLUME 85

Page 206, line 7, *calcarifer* for *calcarices;* line 18, *Glossogobius* for *Glassogobius;* and line 2 from bottom, *cyprinoides* for *cyprinaides.*

Page 207, line 21, *oligodon* for *digodon;* line 9 from bottom, *Rastrelliger brachysomus* for *Pastrelliger brachysomus;* line 4 from bottom, *albipunctatus* for *mechipunetatus;* and line 3 from bottom, *langaray* for *longaray.*

Page 208, line 2, *kalla* for *Kalla.*

Page 209, line 4, *Teuthis* for *Teathis;* line 7, *Leiognathus* for *Leiograthus;* line 11, *fimbriata* for *fimbrista;* line 17, *Oxyurichthys* for *Oxyurichtys;* and line 8 from bottom, *commerson* for *commersoo.*

Page 210, line 2 *chrysozonos* for *crysozonos;* line 4, *Gadus* for *Gradus;* line 6, *taeniopterus* for *taenipterus;* and line 4 from bottom, *brachyosomus* for *bracnyosomus.*

Page 211, line 18, *Donax* for *Domax.*

Page 212, lines 7 and 10 from bottom, *Muraenesox* for *Muraenesoy;* line 8 from bottom, *Sphyrna* for *Spyrna.*

Page 215, line 2 of title, *first-instar* for *fresh-instar*; and line 1 of footnotes, *leucosphyrus* for *leucusphyrus.*

Page 218, line 10, *riparis* for *reparis.*

Page 221, line 8 from bottom, *minimus* for *minimum.*

Page 228, Plate 1, *neomyzomyias* for *meomyzomyias.*

Page 307, line 10, *of* for *or.*

Pages 308–310, Table 1, column 4, — for .... and + for 1.

Page 329, line 1 of title, *studies on* for *studies of.*

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[New names and new combinations are printed in *italics*.]

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